CHAOS, COMPLEXITY, AND ETHNIC CONFLICT: A STUDY IN
THE APPLICATION OF THE PRINCIPLES OF CHAOS AND
COMPLEXITY THEORY TO THE ANALYSIS OF
ETHNIC CONFLICT

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE
Strategy

by

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This thesis examines the application of the principles of chaos and complexity theory to the analysis of ethnic conflict. In the post cold war era, the United States continues to become entangled in ethnic quagmires throughout the world. However, current analytical methods prove unable to encompass the full dynamic of these conflicts. Understanding and prediction suffer. To help overcome this shortfall, intelligence doctrine must now go beyond the principles of Newtonian reductionism and embrace the new science of systems.

This study compares the principles of chaos and complexity theory to ethnic conflict factors contained in an author developed ethnic conflict complexity model (ECCM). Historical examples are superimposed on the model to help illustrate these relationships.

This thesis demonstrates that chaos and complexity theory can aid in intelligence analysis. Combined with the ECCM, these principles provide the analyst a cognitive roadmap. In addition, as illustrated in this study, chaos and complexity theory not only have the potential to revolutionize intelligence doctrine but leadership doctrine as well. Armed with the knowledge of system dynamics, military leaders of tomorrow may learn how to thrive within the maelstrom of conflict.

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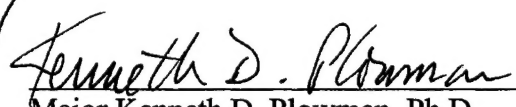
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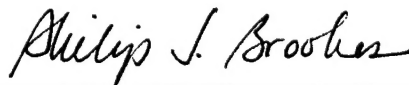
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ABSTRACT

CHAOS, COMPLEXITY, AND ETHNIC CONFLICT by MAJ Micheal L. Current, USA, 112 pages.

This thesis examines the application of the principles of chaos and complexity theory to the analysis of ethnic conflict. In the post cold war era, the United States continues to become entangled in ethnic quagmires throughout the world. However, current analytical methods prove unable to encompass the full dynamic of these conflicts. Understanding and prediction suffer. To help overcome this shortfall, intelligence doctrine must now go beyond the principles of Newtonian reductionism and embrace the new science of systems.

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ACKNOWLEDGMENTS

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CHAPTER 1

INTRODUCTION

> If there is a single power the West underestimates, it is the power of collective hatred. (Peters 1999, 13)

Problem

Over the past decade, the United States has increasingly become engaged in peacekeeping, peace enforcement, and humanitarian operations, primarily in areas rife with ethnic conflict. United States (US) military deployments in the past decade into troubled areas have risen over 300 percent from the previous decade. However, with few guidelines for understanding or resolving ethnic conflict, the leadership in Washington has seen few perceived victories, confounding national policy makers and military commanders. Some implemented courses of action have produced unexpected consequences, disproportionate effects, or outcomes far from the desired endstate. In addition, a lack of understanding, coupled with the guilt of past failures, has led in some cases to national policy paralysis, such as US inaction in 1994 Rwanda following American failure in Somalia. Current intelligence analysis doctrine has proven inadequate in the realm of understanding ethnic conflict.

Primary Research Question

Can the principles of chaos and complexity theory aid in the analysis of ethnic conflict?

Background

Ethnic Conflict in the Modern World

In late 1995 to early 1996 over 60,000 soldiers from across the world poured into Bosnia as part of the new Implementation Force (IFOR). Its mission was to enforce the mandates set forth in the then recently signed Dayton Accords. At its height, IFOR was the largest international force ever sent into a country for the purpose of ending an ethnic conflict. The challenges the newly established force had to overcome were categorized into three general areas: interaction with the indigenous population, coordination, and compatibility with the other countries in the peacekeeping force, and adaptations within one's own force to cope with the new mission.

As a record of these challenges and the solutions found, the National Defense University published in 1997 the book entitled, *Lessons From Bosnia: The IFOR Experience.* The book devotes ninety-three pages to intelligence operations, counterintelligence (CI), and human intelligence (HUMINT). Topics covered include communications interoperability, bandwidth, satellites, computers, declassification, unmanned aerial vehicles (UAVs), and collection management. However, of the ninety-three pages, less than a page is devoted to the difficulties of analyzing the ethnic conflict in Bosnia, and no recommendations on how to do it better are given.

Ethnic conflict is one area that cannot quickly be explained. There are too many relationships, too many factors, and too many actors entering and leaving the scene. It is dynamic and rarely predictable.

> Anticipating and assessing such conflict is highly complex. It requires extensive knowledge of the societies at risk, as well as the ruling elites, history, culture, demography and economy. Also critical is an understanding of the specific social

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groups in those societies and their political relationships to each other and to the state. These factors cannot be analyzed by quantitative techniques alone. (Baker and Weller 1998, 1)

In ethnic conflict, rarely will the American soldier encounter the traditional enemy of rifle and tank. A farmer with horse and till by day may be a machete-wielding murderer by night. The American flag-waving ethnic Albanians, currently being protected by US soldiers in Kosovo, may be the same civilians inflicting reprisals on the ethnic Serbians. All of the stickups on the map turn from red, blue, and green to gray.

The cause of ethnic conflict is one of the most perplexing questions of all questions. Current theories on this subject revolve around the writing of Robert Kaplan, Samuel Hungtinton, and Alvin and Heidi Toffler. Kaplan argues that conflicts arise between social classes as resources become scarce. Samuel Huntington states that: "The great divisions among human kind and the dominating source of conflict will be cultural" (Huntington 1993, 22). Alvin and Heidi Toffler (1993) argue that conflict stems from the clashes between agrarian, industrial, and information waves of human development.

Of importance as well are bottom up and top down theories of state collapse. More specifically, does ethnic conflict tear the fabric that connects a society's institutions, leading to state collapse, or does state failure force populations to find refuge in other forms of collective conscience, such as ethnicity, which in turn leads to conflict? Historical roots, resource scarcity, state failings, an appearing and disappearing enemy, opportunists, and irrational behavior all add up to a complex puzzle, leaving the analyst nostalgic for the cold war.

In light of these few examples on the difficulty of analyzing ethnic conflict described above, it can be understood why intelligence officers find more comfort in

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discussing systems in intelligence collection and dissemination, and not processes of analysis itself. This dilemma is why one finds a book with ninety-three pages on intelligence lessons learned of which less than a page is devoted to the problem of analyzing the enemy. However, now is not the time to hide. Whether one is an advocate of Kaplan, Huntington, or the Tofflers, or whether one is a believer in internal or external sources of state collapse, one can generally agree that ethnic conflict is on the rise.

According to the US Department of State, since the end of the cold war approximately one hundred conflicts have erupted throughout the world, a third of which can be attributed to conflicts based on identity. The Caucasus, Africa, Asia, South America, the Balkans, and Mexico are only a few of the areas that have experienced ethnic conflict in the last decade. Over four million people have died throughout the world in the last thirty years because of ethnic conflict (Baker and Weller 1998, 1). Frustrated by the inability of diplomatic or economic measures to curb this violence, Washington continues to send US soldiers into the fray. "In the American past, the use of military power meant that policy had failed. In America's present, the deployment of troops is a substitute for policy" (Peters 1999, 52).

From 1992 to 1997 the US military conducted twenty-seven operations to areas suffering from internal conflict (Baker and Weller 1998, 6). As long as world resources continue to be distributed unevenly across the globe, as long as opportunists in government continue to bleed a country's wealth for personal gain, and as long as two farmers compete for the same acre of land, ethnic conflict will continue.

After inaction in Rwanda in 1994, the US set a precedence of haphazard involvement in ethnic conflict. Rebel groups throughout the world adjusted their tactics

in an attempt to exploit the new force multiplier: international sympathy. As witnessed in Kosovo and East Timor, the goal of rebel groups shifted from achieving victory to gaining the attention of the international community, especially the international media, long enough to force external involvement.

Just as the Russians did in Abkhazia, United Nations (UN) and North Atlantic Treaty Organization (NATO) peacekeepers provide defacto independence for those areas in which they enter. Whether external military intervention eliminates or only suspends the conflict is yet to be determined. For the US soldier on the ground, the answer is inconsequential. Time is more of the issue at hand.

As Washington has seen in Bosnia, ethnic conflict is a political, economic, and military tar baby: easy to grab, but tough to let go. In his 1992 statement on Somalia, later entitled "A Day in Hell," former US Ambassador to Kenya Smith Hempstone said, "It will take five years to get Somalia not to its feet, but to its knees." Hempstone also stated that the US could only hope "to keep tens of thousands of Somali kids from starving to death in 1993 who, in all probability, will starve to death in 1994." With the advent of a new, long-term mission in Bosnia, it is now time for the intelligence community to develop sound doctrine to meet this challenge.

Intelligence Doctrine and Ethnic Conflict

No longer focused on the threat of the Soviet Union and deemed the world's only remaining superpower, the US moved the protection of human rights into the forefront of its national security objectives. As Washington's political involvement in operations other than war (OOTW) increased, military involvement, or military operations other

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than war (MOOTW), soon followed. Unfortunately, military intelligence doctrine has failed to keep pace.

Current intelligence doctrine for ethnic conflict can be best described as too focused on the wrong stuff. First, current intelligence doctrine on ethnic conflict is focused more on the pieces than the picture. Second, commanders and intelligence analysts focus too much on collection assets rather than on what is collected.

Current doctrine defines for the analyst the various factors in a hostile environment: population dynamics, ethnic factions, police, government, vigilantes, and criminals. It provides examples on how to depict these variables on a map and on how to conduct collection management and dissemination. However, no attention is given on how to put all the pieces together; the heart of any analytic problem.

Understanding the relationships between the pieces is at least as important than the pieces themselves. Without a schema to help analyst put the pieces together, ethnic conflict remains in the realm of intelligence analysis where science becomes art. As IFOR realized in Bosnia,

> It was difficult to collect and exploit the full range of information, identify indicators, and provide predictive analysis. The analysts were trained for hard targeting-based analysis supporting military courses of action; they were not as well prepared for "softer" analysis of political issues, treaty compliance, civil unrest, vigilante activities, election support, refugee movements, and faction and population intentions. Since soft analysis was more challenging and difficult, there was a tendency to be more reactive and analyze what happened rather than predict what might happen. In retrospect, indicators of events were often there-- the challenge was developing the expertise to recognize them and then using these insights to influence outcomes. This placed high demands on intellectual and analytical flexibility. (Wentz 1997, 61)

This thesis does not mean to imply that conventional intelligence preparation of the battlefield is less complex as compared to analyzing ethnic conflict. Intelligence

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analysis for today's battlefield is very difficult. Intelligence officers must compare force ratios and combat multipliers such as command and control systems and intelligence. They then integrate the effects of terrain and weather and of the gray factors, such as leadership, training, and morale, in order to provide the commander a prediction of how the enemy will advance or how a battle will unfold.

The analysis of ethnic conflict, just as in conventional warfare, consists of a multitude of pieces that interconnect like a giant jigsaw puzzle. It is an analyst's job to see the overall picture. Therefore, intelligence analysis should be holistic in its approach. However, without tools of analysis, it is assumed that analysts can dump the puzzle pieces on a table, pick up each piece individually, examine it, and then mentally put all the pieces together. This mental mind miracle expected between input and output is beyond the capacity of most people, leading to incomplete or inaccurate intelligence. The forest is truly lost among the trees.

Advances in technology, like the computer, allow one to process and disseminate vast quantities of information. However, without tools of analysis to provide perspective on the pieces of intelligence speeding down the information highway, intelligence officers self-relegate to the position of traffic cop. And, unfortunately, too many intelligence officers find solace in this position.

It is far easier to master the finite capabilities and limitations of intelligence assets than it is to master what needs collecting or to understand what has been collected. The technological blanket provides comfort, but not warmth. "In this age of technological miracles, our military needs to study mankind. Man, not space, is the last frontier. We must explore him" (Peters 1999, 172).

With the US ever increasingly becoming involved in complex situations with ambiguous endstates, now is the time to think about how to think. As stated by Clausewitz:

> The first, the supreme, the most far-reaching act or judgement that the statesman and commander have to make is to establish . . . the kind of war of which they are embarking; neither mistaking it for, not trying to turn it into, something that is alien to its nature. This is the first of all strategic considerations and the most comprehensive. (1984, 88)

In the nineteenth-century, the concept of energy was transformed from magic to science with the development of the laws of thermodynamics: the total energy of an isolated system does not change, heat will not flow from cold to hot (entropy), and it is impossible to produce absolute zero. The development of tools of intelligence analysis using chaos and complexity theory, as attempted in this analysis, have the potential to bring the art in intelligence analysis closer to the realm of science. This thesis is not a study of ethnic conflict, but the study of how analysts process and examine the information pertaining to ethnic conflict. More specifically, this paper attempts to prove that the concepts of chaos and complexity theory can aid in the analysis of ethnic conflict.

A Revolution in the Human Thought Process

Man has been very quick to capitalize on the abilities of computers and related technology to process vast quantities of information. Bandwidths and bits are exponentially increasing. Caught in the technology systems aspect of computers, man has been slower to realize how computers are and will revolutionize how human beings process and analyze information. In other words, how computers will change how man fundamentally thinks. To understand this concept, one must first step back a few centuries.

In the seventeenth-century, Isaac Newton developed the three laws that govern motion, which gave rise to the general view of nature known as the Clockwork Universe. These laws are:

1. Every object moves in a straight line unless acted upon by a force.

2. The acceleration of an object is directly proportional to the net force exerted, and inversely proportional to the object's mass.

3. For every action, there is an equal and opposite reaction.

Newton's laws ignited a revolution on how man looked at the world, opening the doors to the academic fields of biology, chemistry, and physics. These laws have also been adapted to the softer sciences, such as economics and psychology. However, the foundation of Newtonian analysis is the reducing of systems down to their individual parts. In analyzing the parts, one could understand the whole. This form of analysis became known as Newtonian reductionism.

The analysis of simple, linear models could be supported by precomputer mathematics, all of which had to be done by hand. The math involved in analyzing two variables is tough enough. With three, the longhand is almost impossible. Reductionism then became the norm, dissecting a problem down to its lowest components. Anomalies were dismissed.

Newton's laws changed how scientists process experimental data. At a deeper level these laws changed how humans process and analyze information. Deductive reasoning and inductive reasoning are based on linear analysis. The whole is equal to the sum of its parts, cause and effect, the size of the output is directly proportional to the size of the input: each of these concepts is based on Newtonian reductionism. For three

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centuries Newton's laws, supported by the mathematics of the day, limited scientific analysis to only those systems where two forces could act upon each other, essentially shutting the doors to complex systems. In addition, the simpler the model, the less it mirrored reality; then the computer came along.

Computers have given man the ability to calculate complex equations with multiple variables. No longer enslaved to the stubby pencil and eraser, but still burdened by the chains of linear thought, man has been slow to recognize this new intellectual freedom. Aided by computers, the leap in intellectual thought that humankind is about to make is staggering. This leap is analogous to and possesses all of the ramifications in the realization that the world was round and not flat. As man defines the concepts of complex adaptive systems, the transition over the next few decades in ones thought processes from linear to nonlinear thought can be compared to the thoughts:

> ... confronting early 19th century scientists as they tried to get a grip on a mysterious concept called energy. Today, people take energy so much for granted that it is hard to appreciate how abstract the concept really is. Many people had a pretty good idea what energy did and how it behaved ... But energy was not really understood ... .until people came up with a precise definition. The result was the laws of thermodynamics. (Johnson 1998, 281)

Society has spent three centuries creating a world built upon Newtonian reductionism. From organizational structures of businesses to the categorizations of the sciences, big chunks are divided into smaller chunks down to the eaches. In addition, every peg has its corresponding hole. Margaret Wheatley discussed the need for change in *Leadership and the New Sciences.*

> Each of us lives and works in organizations ... But the science has changed. If we are to continue to draw from the sciences to create and manage organizations, to design research, and to formulate hypothesis about organizational design, planning, economics, human nature, and change process (the list can be much

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longer), then we need to at least ground our work in the science of our times. (1992, 6)

With the advent of new sciences, now is the time to look beyond man's linear conception of world order. A group of scientists, mathematicians, and economists established in 1984 the Santa Fe Institute, where elite from the different academic fields can meet to discuss complex systems and the common patterns. One of the purposes of the institute is to determine if models can be developed that can help explain not-so-anomalous anomalies that were dismissed in the linear models developed before the computer. Although limiting analysis to only two variables helped make the math nice and tidy, these models provided little insight to real world systems.

As one sees in nature, economics, and populations, the world and systems within it are not in equilibrium, an assumption in Newtonian reductionism, but are dynamic, constantly evolving, devolving, changing, unfolding, and unpredictable. Relationships involving three or more variables quickly become nonlinear. With each additional factor, overall dynamics of the system increases exponentially, lending itself to diverse and unpredictable outcomes. As Dr. Phillip W. Anderson, a Nobel Prize winner in physics, succinctly stated, "More is different." Unlike linearity where the answer is always 4, in nonlinearity, "2+2 may yield oranges" (Czerwinski 1998, 9).

Scientists, economists, and sociologist, among others, continue to explore and define the principles of chaos and complexity theory and their utility in understanding complex systems. These principles have the potential to aid in the analysis of ethnic conflict. What Winston Churchill said following the end of World War I is equally true

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today, "The war of the giants has ended; the quarrels of the pigmies have begun" (1929, 17). The time is ripe for development of new intelligence standards.

Significance of Study

On March 16, 2000 Major General (MG) John D. Thomas Jr., Commander of the US Army Intelligence Center and School, gave a briefing to the Army military intelligence officers attending the Command and General Staff Officers Course (CGSOC) at Fort Leavenworth, Kansas. MG Thomas discussed in detail the new doctrine for the intelligence branch. From the tactical, operational, and strategic level, the new doctrine integrates all of the intelligence pieces across the spectrum, potentially providing total battle awareness for commanders at all levels.

Although the new doctrine encompasses all of the intelligence hardware, no new doctrine has been written on aiding intelligence personnel with the thought process of analysis. The focus of current intelligence doctrine is the perfection of the job of information traffic cop described earlier. When the Major General Thomas was questioned about the doctrine shortfall in the analysis process itself, he discussed the change in teaching methods at the intelligence school from one of lecture to that of an experimental approach. This change is positive in that it helps the analysts develop an intuitive thought process: a nonlinear concept itself.

Although this change is in the right direction, introducing analysts to critical thinking early in their intelligence careers, it is far from an endstate. MG Thomas concluded his answer to the question by stating, "Nobody has broken the code on how to do analysis." Based on this conversation, it is apparent that the intelligence community

continues to struggle with to the basic problem of addressing intelligence analysts: how to think about how to think.

This paper is an attempt to apply chaos and complexity theory to the analysis of ethnic conflict for military applications. Although only focused on ethnic conflict the ideas presented may open the door for further studies and models to help explain ethnic conflict using nonlinear theories. From conventional warfare to humanitarian operations, with the aid of computers nonlinear analysis has the potential to minimize the mental mind miracle expected of intelligence analysts today.

In addition, even if this paper determines that the chaos and complexity theory can be applied to the analysis of ethnic conflict, this paper's value is likely to lie more in its faults than merits. The principles of chaos and complexity are still in their infancy, let alone their application to the analysis of ethnic conflict. As future researchers pick apart the findings of this paper, better answers are likely to evolve. Therefore, perhaps the most significant contribution of this paper is its attempt to throw down the gauntlet.

> Surprise is the only route to discovery, the only path we can take if we're to search out the important principles that can govern our work. The dance of this universe extends to all the relationships we have. Knowing the steps ahead of time is not important; being willing to engage with the music and move freely onto the dance floor is what's key. (Wheatley 1992, 142)

Secondary and Tertiary Research Questions

The secondary and tertiary research questions are as follows:

1. What principles of chaos and complexity theory are pertinent to the study of ethnic conflict?

   a. What are the principles of chaos theory?

   b. What are the principles of complexity theory?

c. What is the relationship between chaos and complexity theory?

2. What are the common factors found in ethnic conflict

a. What are the factors of conflict used in the State Failure Task Force

Reports?

b. What are the factors of conflict used in the Baker and Weller report?

c. What are the factors of conflict used in the Rand study?

d. Which of the factors above are applicable to this study?

3. What is the applicability of chaos and complexity theory in analyzing ethnic

conflict?

a. How do the principles of chaos and complexity theory compare to the

factors of ethnic conflict?

b. Do the principles of chaos and complexity theory help explain specific

events in ethnic conflict?

Assumptions

Linear models are inadequate to explain ethnic conflict. The factors involved in

the analysis of ethnic conflict, their relationships, and weighting are just too complex.

Imbedded in the foundation of complex adaptive systems is the notion that prediction of

complex systems is near term at best. An understanding of the bounds and

interrelationships within the complex system is in itself of value to the commander or

national policy maker.

Limitations

Because of time constraints, the paper cannot address all ethnic conflicts nor can

it address all factors within ethnic conflicts. Since principles for chaos and complexity

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theory are continuously being developed, the paper cannot address all of the theories. Because of time constraints, this paper does not develop future intelligence doctrine.

Delimitations

This paper is not a study of any particular ethnic conflict. It examines a variety of examples of ethnic conflicts to put the factors into perspective. The factors that this thesis examines are those within the State Failure Task Force reports, the Baker and Weller study, and the Rand study on ethnic conflict. These factors are then narrowed to only five factors of ethnic conflict. The selection of these five factors is based on their initial relationship to the principles of chaos and complexity theory.

This paper does not examine specific ethnic conflicts for the purpose of determining common patterns. It relies on other collective research, which analyze and define the factors within ethnic conflict. Studies of specific ethnic conflicts are used to provide examples or the factors of ethnic conflict, and at times, their relationship to the principles of chaos and complexity theory. The specific ethnic conflicts that this paper may address are limited to Rwanda, Bosnia, and Abkhazia.

This paper does not develop any new nonlinear theories. It attempts to mesh current nonlinear models to common patterns found in ethnic conflicts. Lastly, this paper limits the principles examined to those parts of chaos and complexity theory that are deemed relevant to the writer in the analysis of ethnic conflict.

This thesis recognizes that a linear methodology is used in this paper to determine if nonlinear theories are applicable to the analysis of ethnic conflict. The principles, or parts, of chaos and complexity theory are examined in relation to the factors, or parts, of ethnic conflict. In both instances, recognizing that the examination of just the parts is

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limited in explaining the complex and dynamic nature of chaos and complexity theory and ethnic conflict.

In addition, little time is spent in this paper examining the holistic side of chaos and complexity theory and ethnic conflict. It is understood that the value of these theories lies within the relationships of the parts and the systems as a whole. However, because of time limitations, such a study is beyond the scope of this paper. This thesis needs only to demonstrate a potential application of chaos and complexity theory to the analysis of ethnic conflict. Future studies can build upon the foundation of this paper for a more complete analysis of the application of nonlinear theories to ethnic conflict.

Definitions

Addivity. The whole is equal to the sum of its parts: 2+2+2=6. Addivity is critical to linear analysis since straight line prediction is based upon this principle. In chaos and complexity theory, the interrelationship between two elements may add to a linear total, they equal a number far less or greater than the linear total, or they may yield an entirely different patterns of answers.

Agents/elements. Individual, autocatalytic elements that interact within a system or community. Elements are the pieces within a system. Elements can be grouped to form one element, or each piece looked at individually depending on the level of detail or importance of the element. For example, an ethnic group can be described as one element, subgroups within the ethnic group may be described as elements, and individuals within the subgroups may also be described as elements. The differentiating factors to determine what defines an element would be the level of analysis, the potential

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of subelements to behave dissimilarly to the larger element, and the weighting of each level of elements.

Autocatalitic. Independent actions of elements within a system resulting (hopefully) in change to self and to system (auto: self; catalytic: inspiring change). This definition goes back to the principles of chaos and complexity theory which state that elements can change without the need to an outside catalyst.

Bifurcation. To divide into two parts. It is where in a sequence of events a system has the potential to take one of several paths. Although the term is bifurcation with the root word bi, meaning two, the term is not limited to two choices. Bifurcation is just an area where a system must go down one of a multitude of potential choices. Bifurcations are related to fractals which are repeating patterns found within a system.

Butterfly effect. The phrase that denotes that small variables effect large changes within a system; chaos theory, edge of chaos. The phrase goes back to an old, and somewhat misunderstood chaos theory saying that a butterfly flapping its wings in Panama changes the direction of a hurricane in Florida. Although somewhat dramatic, this saying does help illustrate the principles that measurement is never accurate to the infinite detail. Because of such, seemingly similar events may start off looking exactly the same may produce dramatically different results. Since it is an assumption of chaos and complexity theory that events cannot be measured to infinite detail, discrepancies between what is seen and what is actually happening will always prevail. Thus, long term prediction of chaotic systems is meaningless.

Complex. An intricate association of individual parts forming a whole.

Complex adaptive systems (CAS). The engine that drives nonlinearity. These systems, exhibit coherence under change, via conditional action and anticipation, and they do so without central direction. They are self-organizing, evolving, devolving, dynamic, rarely predictable, and not proportional nor additive.

Complexity theory. A theory, based upon chaos theory, which states that evolution occurs most effectively through interaction. Complexity theory lies within that realm of stability at the edge of chaos. In this dynamic areas where systems are sliding into chaos, complexity theory states that elements can individually, or through the interaction with other elements evolve to become more organized.

Edge of chaos. This is a point between chaos and stasis where evolution is most likely to occur. As one moves to the left of the edge of chaos, a system goes from complex to simple. As one moves to the right of the edge of chaos, systems quickly break down and demonstrate seemingly erratic behavior.

Elements. The independent entities within a system. See the definition of agents.

Emergent properties. Properties or characteristics that directly result from interactions within or between complex systems and environments. Emergent properties are those changes within elements that may lead to evolution or organization.

Fractal properties. These are patterns that repeat themselves from the macro down to the micro level. For example, branches on a tree have the same dividing pattern from the base to the leaves. If one looks even closer, the veins within the leaves continue the same branching pattern down to the cellular level.

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Interactions. Behaviors and communications occurring in direct reaction with other elements, systems or environments. As stated earlier, interactions are not necessary for changes in elements. However, it is the interactions that result in changes to the elements that may change by themselves between interactions, that feed into the next interaction that forms the complex adaptive system.

Lever points. Areas within CAS where small inputs produce large outputs. Specific areas within a system may be identified that seem to have a controlling and pronounced impact on the entire system. If one can identify lever points and understand the changes within the system caused by these, one may be able to change the entire system dramatically by interjecting a slight change at the lever point. Of equal consequence, not knowing the lever points, but haphazardly injecting a change at one of these may produce a sequence of drastically undesirable outcomes far from ones original intent.

Linear. Pertaining to a line or lines. Characterized by extension, direction, or motion along one dimension only. Linearity includes the concepts of proportionality, additivity, replication, and demonstrability of causes and effects. Linear is what chaos and complexity theory is not about. However, one must understand linear analysis to be able to recognize an actual complex system. Some seemingly complex systems are actually linear because they can be explained using linear equations. Long-term predictions can be conducted of a complex system which can be described though linear equations since the system, although complex, is following simple, linear rules. In a truly complex system, long-term predictions are meaningless. With each feedback loop the outcome changes that then changes the next input cycle.

Linear reductionism. Taking a complex system and simplifying into simple, manageable parts. Even in the analysis of complex systems with the principles of chaos and complexity theory one must use some degree of linear reductionism. When developing a complex model of a particular ethnic group, one cannot look at each individual member of the ethnic group. One has to make a judgment on which parts of the ethnic group will act as one element as a whole (the nameless masses for example), which subgroups of the whole may act independently (active religious, political, military, or terrorist organizations), and which individuals may act as an element by themselves (key political, religious, or military figures).

Nonlinearity. A term that encompasses nonlinear concepts to include, deterministic chaos, fractals, self-organizing systems from thermodynamic equilibrium, complexity and complex adaptive systems, and self-organizing criticality.

Proportionality. Little inputs result in little outputs. Big inputs result in big outputs. Proportionality is one of the tenants of linear systems. In nonlinear systems, little inputs can produce large outputs, or large inputs can result in very small outputs. In addition, inputs can produce an entirely different relationship of outputs.

Replication. Similar inputs into similar problems will produce similar results. Linear systems can be explained using linear equations and can be repeated. Replication is another tenant of linear systems. One has inputted x into system y to produce effect z. One has done this fifty times, therefore it can be predicted with relative certainty that input x in system y with produce effect z for the next fifty time. One can also assume that in any system y that x will produce z. This is not the case in nonlinear systems. Not only

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will similar y systems react differently to input x, the same y system will react differently with each x input, producing z, a, d, e, *four, eleven, zebra, or banana*.

Strange attractors. Areas around which behaviors and interactions tend to occur. Attractors are areas where over time events seem to converge. They are "a basin of attraction, an area displayed in computer-generated phase space that the system is magnetically drawn into, pulling the system into a visible shape" (Wheatley 1992, 122). If two lines one a graph both began at zero, separated, and then crossed each other at five, then the attractors for those two sets of lines would be zero and five. In a social system involving two ethnic groups, the strange attractors may relate to two observable and distinct levels of cooperation or conflict between the groups. Understanding these attractors may then help to understand the parameters between the two attractors. It may also help to form policy by understanding the level of cooperation or conflict one can expect between the two groups when trying to interject into the system.

System. Unified whole of different independently acting entities. All of the parts of the weather make up the weather system. One has to define a system just as one has to define the elements within the system. Linear reductionism again comes into play. When looking at an ethnic conflict, it may not be practical (and in most cases is not) to define ones system as the entire world. One may define the system in terms of geographical context, or based on culture. However, a clear idea of what constitutes the system studied is essential to take full advantage of the holistic style of analysis, and to limit the number of surprises when following a complex system.

The above terms and definitions are common definitions and have been appropriated and paraphrased from various complexity theory sources including the

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following: M. Michell Waldrop's *Complexity: The Emerging Science at the Edge of Order and Chaos* (1992), James Gleick's *Chaos* (1987), and Williams' *Chaos Theory Tamed* (1997).

Conclusion

Chapter 1 defines the intent, scope, limitations, and importance of this thesis. In addition, it provides the reader an introduction to chaos and complexity theory and ethnic conflict, and how these theories are relevant to the post Cold War world. Chapter 2, Literature Review, includes a comprehensive examination of the current research conducted in these areas. This chapter answers the first secondary research question by first defining the principles of chaos and complexity theory and then narrowing these principles to those deemed pertinent to this study. Chapter 2 also answers the second secondary research question by defining the factors of ethnic conflict and then narrowing these to only five.

Chapter 3, Research Methodology, describes the qualitative analysis approach and specifically the three phases of analysis this paper uses to answer the three secondary research questions. Chapter 4 is a comparison of the chosen six principles of chaos theory and the four principles of complexity theory to the five chosen factors of ethnic conflict. This chapter also includes a brief examination and comparison of the holistic nature of chaos and complexity theory and ethnic conflict. Chapter 5 concludes this thesis by summarizing its findings and providing suggestions for further study.

CHAPTER 2

LITERATURE REVIEW

> I shall proceed from the simple to the complex. But in war more than in any other subject we must begin by looking at the nature of the whole; for here more than elsewhere the part and the whole must always be thought of together. (Clausewitz 1984, 75)

Introduction

Chapter 2 is both a literature review of various studies on chaos and complexity theory and ethnic conflict and an analysis of these principles and factors as they apply to this thesis. This chapter is divided into four main areas. Part one under the introduction discusses the three categories of literature used throughout this thesis. Part two of chapter 2 is a literature review and listing of the principles of chaos and complexity theory. Part two concludes by narrowing and defining those principles of chaos and complexity theory that continue to chapter 4.

Part three of chapter 2 is a literature review and listing of the factors of ethnic conflict. Part three concludes by narrowing and defining those factors of ethnic conflict that are compared to the principles of chaos and complexity theory in chapter 4. Part four, Conclusions, summarizes the findings of this chapter and introduces chapters 3 and 4.

There were no studies found that directly applied the concepts of chaos and complexity theory to the analysis of ethnic conflict. However, ample to extensive research has already been done in the three categories of information this paper draws upon to conduct analysis and formulate conclusions. These categories are:

1. Category I: Research pertaining to the principles of chaos and complexity theory.

2. Category II: Research pertaining to the common patterns found in ethnic conflict.

3. Category III: Research pertaining to specific ethnic conflicts.

For each of the categories, information is found across the media spectrum: books, journals, magazines, newspaper articles, institute studies, websites (complexity theory), theses, and monographs. This chapter first conducts a literature review of the research conducted in the literature categories. The thesis then synthesizes the views of the various authors to narrow the principles of chaos and complexity and the factors of ethnic conflict utilized in chapter 4.

Chaos and Complexity Theory

Research pertaining to the principles of chaos and complexity theory is the foundation of the thesis for it defines these principles. The bible for complexity theory is *Complexity: The Emerging Science at the Edge of Order and Chaos* (1992) by M. Mitchell Waldrop. This thesis refers to it as the complexity bible for it contains all of the aspects of the theory: the principles, the people who created it, and the history of its evolution. The *Washington Post* described it best as "the most exciting intellectual adventure story of the year" (Waldrop 1992, cover). However, because it is so encompassing, extracting all of the gems that pertain to this paper would be a lengthy and tedious process. It is like studying Clausewitz. It is far easier to study the works of knowledgeable authors who write about Clausewitz than to study *On War* as a whole.

Therefore, although this paper recognizes the importance of Waldrop's book in capturing complexity theory, it only refers to it on occasion.

The most simplistic, straightforward approach in explaining chaos theory is Major Glenn James' *Chaos Theory: The Essentials for Military Applications* (1996). James first defined the difference between chaos with a little "c" and Chaos with a big "C." The difference between the two is that while the former is just random, unpredictable motion, the latter "describes a specific range of irregular behaviors in systems that move or change" (James 1996, 3).

James asserted that a chaotic system must be bounded, nonlinear, non-periodic, sensitive to small disturbances, and mixing. He also stated that a chaotic system usually exhibits transient and limit dynamics, parameters (control knobs), definite transitions to and from chaotic behavior, and attractors (often with fractal dimensions). James went through each of these parameters, defining and explaining each in nonmathematical terms. The author concluded by providing an overview of why military personnel, beyond intelligence analysts, have a great deal to gain from understanding chaos theory.

The article "Chaos" (1986) by James Crutchfield, J. Doyne Farmer, Norman H. Packard, and Robert Shaw is another work that described chaos theory, its limitations, and its parameters. The article demonstrated chaotic behavior in even simple systems, and explained how chaos systems are deterministic, even if prediction within a chaotic system is limited. The article concluded that: "Chaos imposes fundamental limits on prediction, but it also suggests causal relationships where none were previously suspected" (Crutchfield 1986, 46).

Although Steven Rinaldi's article "Complexity Theory and Airpower: A New Paradigm for Airpower in the 21st Century" (1997) focused primarily on the evolution of airpower theory from linear to nonlinear thought, the article provided a good summary of the definition of linear systems and complex adaptive systems (CAS). CAS is the system wherein chaos and complexity forms. A linear system has two characteristics:

> First, it displays proportionality. If some input X to the system gives an output of Y, then multiplying the input by a constant factor A yields and output of AY. The second characteristic of linear systems is superposition. That is, if inputs X_1 and X_2 give outputs Y_1 and Y_2 respectively, then an input equal to $X_1 + X_2$ gives an output of $Y_1 + Y_2$. (Rinaldi 1997, 250)

The author continued by defining complex adaptive systems as having four tenets: emergence, self-organization, evolution at the edge of chaos, and the ability to process information.

Rinaldi argued that military theorists have viewed warfare through the Newtonian paradigm based on Newtonian physics and applied metaphorically to the art of war. Rinaldi stated that the three tenets of the Newtonian paradigm are:

1. Warfare is deterministically predictable.

2. Reductionism, or breaking the whole down to its constituent parts, and the summation of these parts will explain the whole.

3. Systems are closed entities, isolated from their environments.

Rinaldi concluded his article by stating that a shift from the Newtonian to the complexity paradigm may serve military theorists better in explaining the true nature of warfare. Furthermore, he stated that the complexity paradigm may prove most useful in holistic targeting.

Another book considered the standard in the field of complex adaptive systems is *Chaos: Making a New Science* by James Gleick (1992). However, this book is as encompassing in explaining chaos theory as Waldrop's book is for complexity theory. Therefore, it is only to be referred to only on occasion.

Unleashing the Killer App (1998) by Larry Downes and Chunka Mui is the business application of events that act as accelerators and triggers of extreme change. Accelerators are feedback events that combine with the other factors to increase the escalation of conflict. Triggers are events that propel a high-risk situation into the next level of escalation.

Killer apps take these concepts a step further by trying to define agents where secondary, tertiary, and quaternary effects caused by one incident can change the entire system. Eight days after CNN's thirty-second spot of dead American pilots being dragged through the streets of Mogadishu, the US left Somalia. The understanding and application of killer apps by the least technologically advanced enemy can prove deadly for any US foreign policy objective.

Susanne Kelly and Mary Ann Allison's *The Complexity Advantage* (1999) is another book that suggests business applications of complexity theory. After a small introduction on principles, the book, in nonmathematical, terms explained how companies can thrive in today's dynamic business world using complexity theory.

There are also a number of books that have combined chaos and complexity theory with military affairs and warfare. The two most prominent works in this category are *Complexity, Global Politics, and National Security* (1997) edited by David S. Alberts and Thomas Czerwinski, and *Coping with Bounds: Speculations in Nonlinearity in*

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Military Affairs (1998) edited by Thomas Czerwinski. Both of these books, published by the National Defense University, are a collection of articles or speeches on chaos and complexity theory, and their application to politics, national security, and military affairs. Because these books are a collection of works by different authors that directly relate to this category, this thesis draws extensively from these two books.

Robert Jervis's article "Complex Systems: The Role of Interactions" (1997, 45) is a nice introduction into causal relationships. The author discussed how all actions have unintended consequences: "We can never do merely one thing" (48). It is this interrelationship that is important in the analysis of ethnic conflict or when attempting to interject stability factors, or deaccelerators, into the situation.

The main point of Jervis' argument was that unintended consequences might produce secondary and tertiary effects that can change the system as a whole. Therefore, identical actions separated by time will not provide identical results since a system adapts or changes from when an action is first taken (Jervis 1997, 60). Jervis' article concluded by stating that in national policy it is often not the case to think of political or national policy decisions to be part of a system because interactions and humanistic factors do not fit into a clean, simple system. However, it is imperative that one does consider these factors as a system if one is ever to gain an understanding of the situation and initiate effective action.

James Rosenau in his article "Many Damn Things: Complexity Theory and World Affairs" (1997) analyzed the limitations of complexity theory in prediction. The author began by discussing how simplistic the world seemed during the Cold War.

Although this period had many negative sides, people felt more at ease because situational outcomes could be predicted with some level of accuracy.

The world after the Cold War is presumed to have become more complex. To help come to grips with this complexity, analysts are turning to complexity theory and other related theories based on CAS for the answers. However, since the theory itself is in its infancy, answers will not be easily found. Once discouraged, people may again find refuge in the more simplistic models.

Rosenau (1997) discussed the CAS that is the underlining foundation of chaos and complexity theory.

> [CAS] is distinguished by a set of interrelated parts, each one of which is potentially capable of being an autonomous agent that, through acting autonomously can impact on the others, and all of which either engage in patterned behavior as they sustain day-to-day routines or break with the routines when new challenges require new responses and new patterns. The interrelationships of the agents is what makes them a system. (Rosenau 1997, 82)

Rosenau (1997) asserted that complexity theory is very limited in prediction because systems are so sensitive to initial conditions. Because CAS is adaptive, slight variations in initial conditions can produce dramatic variations in the outcomes. The author stipulated that, "It [Complexity Theory] cannot presently and is unlikely ever to provide a method for predicting particular events and specifying the exact shape and nature of developing events in the future. As one observer notes, it is a theory 'meant for thought experiments rather than for emulation of real systems'" (89).

Rosenau concluded by stating that computer simulation models based on complexity theory are a long way away from providing the precision for prediction in the political realm. Thus, complexity theory will not be the hoped for panacea to explain

today's problems. Without immediate gratification analyst may reject complexity theory altogether, which is unfortunate. New theories, such as chaos and complexity theory, are of value in that they help define the parameters of a situation and provide insight into the limitations that one has in effecting the outcome.

Alvin M. Saperstein in "Complexity, Chaos, and National Security Policy: Metaphors or Tools" asserted that chaos theory and complexity theory currently serve as metaphors rather than tools since quantitative tools based on these theories have yet to be developed. "It is not evident to me that a single metaphor or tool--like Chaos--is available or useful to us in dealing with a world system characterized by 'complexity.' Instead of specific tools, these metaphors can contribute to the development of the new attitudes required for the more complex modern world" (Saperstein 1997, 120). Saperstein concluded his article by stating that the most useful aspect of the chaos and complexity metaphors is their ability to remind us to remain cognizant of chaos in our attempt to avoid it.

From the studies described above, one can come to recognize that chaos and complexity theory, although new concepts, will serve a progressively greater role in explaining the world and its systems. Rinaldi (1997) described the shift from Newtonian reductionism to chaos and complexity in the human thought process. James (1996) applied chaos theory to military applications, especially technological systems such as communications and computers. *The Complexity Advantage* (1999) and *Unleashing the Killer App* (1998) apply chaos and complexity principles to business systems, and Steven Mann (1997), discussed below, described the application of these theories to world systems.

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Some of the researchers illustrated above examined the current limitations of chaos and complexity theory in understanding a system and making predictions. However, each study above recognized that chaos and complexity are still in their infancy. Furthermore, they also recognize that continued research is warranted. Chaos and complexity are not a fad. They will not fade away like pet rocks and bell-bottom jeans. Children of the next generation will study these theories in high school along with current conventional physics and biology.

Chaos and complexity are the science of systems. They are new because only with the advent of the computer has man had the technological ability to mathematically model complex systems. The path to understanding chaos and complexity will be long and difficult. However, the most difficult step is the first: the mental leap from Newtonian reductionism to complexity.

In Steven R. Mann's "The Reaction to Chaos," (1997) the author asserted that the analytical community needs to take the necessary steps to develop a model that helps explain the complex world of today. He also provided its tenets. "A successful model--if it can be created--will encompass military strategy, trade and finance, ideology, political organization, religion, ecology, mass communication, public health, and changing gender roles" (Mann 1997, 139).

Mann's article first reviewed the principles of self-organized criticality (SOC). It then continued to explain how US policymakers continue to try to view and shape the world into a state of static equilibrium. Mann pointed out that periods of critical reordering are normally followed by extended periods of quiet. Thus, a chaotic period is not an anomaly, but an integral part of the whole system. Mann concluded his article by

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stating that when faced with a period of self-organized criticality, "we need to understand the nature of the environment we face, go against our cultural patterning, and recognize that not all chaos is bad and not all stability is good" (Mann 1997, 147).

The idea that sometimes instability is a good thing is an important concept that policymakers need to recognize whenever the notion of intervening into an ethnic conflict is raised. The US stood idly by as more than one-half a million Tutsis were massacred in Rwanda in 1994. However tragic, this chaotic period was allowed to play itself out free of outside intervention. After a chaotic period, the country found a new equilibrium. Five years later, Rwanda is now a self-sufficient, somewhat stable country.

The chaotic period in Bosnia, however, was not allowed to play itself out. Intervention prevented the system from finding a new equilibrium. Or perhaps more precisely, the equilibrium reached was entirely based on the support of outside intervention. As such, equilibrium is still dependent upon that support. It is a common belief among analysts that Bosnia will remain a basket case for generations. Economically, Bosnia is a foreign aid black hole; Rwanda is not. It is not the intention of this paper to suggest that ethnic genocide is a more desirable option than outside intervention. However, by understanding complex systems, one may have a better understanding of the limitations and responsibilities, especially in terms of time and resources, that intervention may involve.

In "Clausewitz, Nonlinearity, and the Importance of Imagery," Alan D. Beyerchen agreed with Rosenau in that the analytical community may be premature in placing too much hope in the chaos and complexity theory as a tool in understanding the fractionating world of today. He asserted, however, the importance and strength of these

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instruments lie in their use as metaphors. Beyerchen concluded his article by stating that a modeling system, yet to be created, that allows self-organization would be more realistic than current predictive models. "The issue is not that we lack information about the world; it is that we need better schemata. We do not know enough about the new sciences to apply them very well yet, but every attempt helps us learn and adapt to the changes with which we must cope" (1998, 168).

Another important book is Garnett Williams' *Chaos Theory Tamed* (1997). This book provided the foundation for this paper in defining the principles of chaos theory. However, the title is deceiving. The dust jacket described the book more aptly.

> Chaos is a mathematical subject. If you seek bodice-ripping romance, this book is not for you. But if you are a researcher working with data . . . a scientist, engineer, or economist who has specialized outside the field of mathematics . . . or an interested person with a bit of background in algebra and statistics. . . then *Chaos Theory Tamed* can help you understand the basic concepts of this relatively new arm of science.

Each of the research works above is important in the study of the application of the principles of chaos and complexity theory to the analysis of ethnic conflict. Gleick (1987), Williams (1997), Waldrop (1992), Czerwinski (1997 and 1999) and James (1996) established the principles of chaos and complexity. James (1996) and Czerwinsi (1997 and 1999) also demonstrated military applications of these principles. Kelly and Allison (1999) and Downes and Mui (1998) demonstrated business applications. The subsequent paragraphs in this section of chapter 2 are a synthesis of the principles of the complex adaptive system (CAS), chaos theory, and complexity theory as outlined in the readings above.

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The foundation for chaos and complexity theory is the complex adaptive system (CAS). Detailed in chapter 1 under definitions, a system is a unified whole of different independently acting entities. A complex adaptive system is exactly what the name specifies. It is complex and adaptive.

A CAS is composed of a set of interrelated elements, each of which can act upon each other or act in an autonomous fashion. These pieces can engage in patterned behavior or separate and act independently. In addition, these elements can collectively, or individually, adapt to changes within the system.

> The interrelationships of the agents is what makes them a system. The capacity of the agents to break with routines and thus initiate unfamiliar feedback processes is what makes the system complex (since in a simple system all the agents consistently act in prescribed ways.) The capacity of the agents to cope collectively with new challenges is what makes them adaptive systems. (Rosenau 197, 83)

In his book *Chaos Theory Tamed* (1997), Garnett Williams listed sixteen characteristics of chaos theory. As mentioned earlier, Williams's list is the most comprehensive as well as succinct out of all the readings described above, and as such, this thesis uses Williams's list as its foundation. William's sixteen characteristics of chaos are:

1. Chaos results from a deterministic process.
2. It happens in only nonlinear systems.
3. The motion or pattern for the most part looks disorganized and erratic, although sustained. In fact, it can usually pass all statistical tests for randomness.
4. It happens in feedback systems-systems in which past event affect today's events, and today's events affect the future.
5. It can result from relatively simple systems. With discrete time, chaos can take place in a system that has only one variable. With continous time, it can happen in systems with as few as three variables.

6. For given conditions or control parameters, it's entirely self-generated. In other words, changes in other (i.e. enternal variables or parameters aren't necessary.
7. It isn't the result of data inaccuracies, such as sampling error or measurement error. Any particular value of x_t (right or wrong), as long as the control parameter is within an appropriate range, can lead to chaos.
8. In spite of its dijointed appearance, it includes one or more types of order or structure.
9. The ranges of the variables have finite bounds. The bounds restrict the attractor to a certain finite region in phase space.
10. Details of the chaotic behavior are hypersensitive to changes in initial conditions (minor changes in the starting values of the variables).
11. Forecasts of long-term behavior are meaningless. The reasons are sensitivity to initial conditions and the impossibility of measuring a variable to infinite accuracy.
12. Short-term predictions, however, can be relatively accurate.
13. Information about initial conditions is irretrievably lost. In the mathematician's jargon, the equation is "noninvertible." In other words, we can't determine a chaotic system's prior history.
14. The Fourier spectrum is "broad" (mostly uncorrelated noise) but with some periodicities sticking up here and there.
15. The phase space trajectory may have fractal properties.
16. As a control parameter increases systematically, an initially nonchaotic system follows one of a select few typical scenarios, called routes, to chaos (1997, 209-210).

This study lists Williams' sixteen principles of chaos because they are the most complete. It encompasses all the other works that list the principles of chaos theory. Since chaos and complexity are still in their infancy, there is yet an overall consensus on the underlining principles. In addition, depending on the focus of the research being conducted, different principles are emphasized, while others are combined.

Williams's book is primarily oriented towards the mathematical applications of chaos theory. Although separated into sixteen distinct principles for the purpose of later designating a mathematical equation to each, this level of detail is not necessary in the social scientific type application of those principles as attempted in this paper. Comparing Williams's principles to other research on chaos theory and how it has been

applied in social sciences to include military affairs and warfare, this thesis narrows Williams's list of sixteen principles to six. These six principles of chaos theory are used in chapter 4. They are:

1. Chaos results from a deterministic process. The motion or pattern for the most part looks disorganized and erratic, although sustained. In fact, it can usually pass all statistical tests for randomness. Although the sequence of chaotic behavior appears erratic, it does follow rules. "That is, some law, equation, or fixed procedure determines or specifies the results" (Williams 1997, 5).

2. Chaos happens in feedback systems--systems in which past events affect today's events; and today's events affect the future. Positive feedback accelerates the output; negative feedback decelerates the output. Margaret Wheatley describes the relationship between chaos and feedback systems. She states, "Chaos of this nature (known as deterministic chaos) is created by iterations in a non-linear system, information feeding back on itself and changing in the process" (1992, 125).

3. For given conditions or control parameters, chaos is entirely self-generated. Changes in other variables or parameters aren't necessary. Elements may act independently, changing or organizing by themselves. This principle is quite important when compared to linear systems. A system based on linear analysis is said to be static until injected upon by an exterior force. In a nonlinear system, change can occur within a system that is entirely devoid of exterior influence. The principle of self generated changes bleeds over into self-organization: a principle of complexity theory discussed below.

4. The ranges of the variables have finite bounds. The bounds restrict the attractor to a certain finite region in space. An attractor is a point in space where events appear to congregate. Although it seems in chaotic systems that any direction is possible, at each point in time there are bounds that limit the number of choices.

5. Details of the chaotic behavior are hypersensitive to changes in initial conditions. Forecasts of long-term behavior are meaningless because of the sensitivity to initial conditions and the impossibility of measuring a variable to infinite accuracy. Short-term predictions, however, can be relatively accurate.

6. The phase space trajectory may have fractal properties. A fractal property is a geometric pattern that repeats itself from micro to macro scale.

These six principles of chaos theory--deterministic, feedback, self-generating, finite bounds, sensitivity of initial conditions, and fractal properties, are sufficient in the examination of chaos theory and its application to the analysis of ethnic conflict. This study does not mean to imply that the nine principles listed by Williams (1997) that were not directly selected are not important. However, the six principles chosen were relevant to the analysis used in this thesis whereas the other principles were not.

This thesis considers it a foregone conclusion that ethnic conflict takes place in a complex, nonlinear system. Therefore, it is not necessary to address the William's (1997) second or fifth principle of chaos. Williams' third principle pertains to statistical measurement. This principle is more important to the application of an ethnic conflict model than to the comparison of the factors of ethnic conflict. Principle seven pertains to a system transitioning into chaos. Ethnic conflict resides in a system that is already at the edge of chaos or is in chaos.

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Principle eight--the system includes one or more types of order, is another principle that is considered a given in the ECCM developed in chapter 4. Principles eleven and twelve that pertain to prediction in a system will be important once an ethnic conflict model is developed. They will help define realistic expectations of models based on chaos theory. However, they are not as important in this thesis which only needs to demonstrate the potential of the principles of chaos and complexity theory to the analysis of ethnic conflict.

Principles thirteen and fourteen primarily pertain to the mathematical application of chaos theory. Therefore, they are not significant in the social-science application of chaos theory as attempted in this paper. These two principles will be of more value in future studies that attempt to mathematically define an ethnic conflict model.

Finally, principle sixteen pertains to systems moving towards the edge of chaos. As stated earlier, a system that contains ethnic conflict is already there. Each of the six selected principles of chaos theory--deterministic, feedback, self-generation, finite bounds, sensitivity to initial conditions, and fractal properties, can be compared to the factors of ethnic conflict. These six principles are also closely related to the four principles of complexity theory described below.

Complexity theory builds upon chaos theory. As outlined in the readings above, complexity theory asserts that within the edge of chaos elements of the system, instead of falling into chaos, can adapt to the changes and evolve. In addition, although elements can act totally independent and go in any direction, they normally do not. It is the dynamic property of the edge of chaos that allows the freedom of elements in the system to either evolve or become extinct. Complexity theory is based upon four principles.

1. The first principle of complexity theory is self-organization and emergent properties. For self-organization, elements of a CAS can interact with each other to form a higher, more organized pattern. Emergent properties are those properties within a system that are formed because of an interrelationship between two elements. Emergent properties are what allow elements to adapt and evolve.

2. The second principle of complexity theory is adaptation and coevolution. For adaptation, with each of the elements of a CAS, there is an ability to maintain ones' core identity, while at the same time adjusting to changes caused by the interaction with other elements of the system. If an element fails to adapt, its core becomes less and less congruent. This element is then less fit to survive in a dynamic system of competing elements. Eventually, the less fit element falls over the edge and into chaos. Some of its parts may absorb into other elements.

Tied to adaptation is the concept of coevolution. Two elements within a system, feeding off each other's adaptations, become fit to survive within the system. These adaptations would not have been possible for the elements by themselves. It is only through the interaction with the other element that changes, or emergent properties, arise. Their interrelationship allows both elements to evolve within the system. The evolutionary process within a system can happen evenly over time or in bursts. The latter type of evolution, known as punctuated equilibrium, is characterized by long periods of stasis separated by periods of transformation.

3. The third principle of complexity theory is disproportionate effects. Unlike in a simple, linear system where output is directly proportional to input, a CAS is sensitive to small changes. Because of the number of elements and the complexity of their

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interrelationships, small inputs can ripple throughout the system, cascading into large outputs. Earlier, this thesis used the example that eight days after the pictures of dead American soldiers were shown on television the US pulled out of Somalia to demonstrate the concept of disproportionate effects. Another example would be the conditions in early twentieth century Europe where the assassination of one man led to World War I.

4. The fourth principle of complexity theory is that of sensitivity to initial conditions. Related to the principle of disproportionate effects, the fourth principle states that slight variations in initial conditions can produce vast differences in outcomes. Because of the complex nature of a CAS and the limitations of current instruments to measure a system to infinite detail, it is impossible to exactly measure the current, or immediate, condition of a complex system. For this reason two seemingly identical systems can actually contain slight differences. These slight variations applied to the principle of disproportionate effects lead to vast differences over time. The principle of sensitivity to initial conditions is why weathermen have difficulty predicting the weather beyond a few days with any level of fidelity.

When complexity theory is analyzed separate from chaos theory, it is composed of the four principles described above. However, it must be reiterated that complexity theory is dependent upon the principles of chaos theory. It is within the dynamic of a complex system that elements can either fractionalize into chaos or adapt and coevolve, becoming more complex. Therefore, defining the principles of complexity theory separate from chaos theory is both easy and complex.

It is perhaps easier to distinguish the difference between the two theories by looking at their relationship to conventional science. Chaos theory is rooted in the

science of physics. Here, enthalpy is always declining and entropy is always increasing. The ultimate resting point of any system is maximum entropy or chaos. On the other hand, complexity theory is rooted in the science of biology. Although systems break down, for mutual benefit elements tend to organize into complex systems. As the system's fitness increases, so does the fitness of its component elements.

The four principles of complexity theory illustrated above are from Ronenau's article (1997) described earlier in this chapter. Since Rosenau defined the principles of complexity theory in relation to world systems, they are directly applicable to this thesis in the analysis of ethnic conflict. One may also notice that one of the principles-- sensitivity to initial conditions, is listed under both chaos theory and complexity theory. This duplication illustrates the difficulty in separating the two theories. However, if this thesis eliminated the sensitivity principle from either list to correct this duplication, then one of the theories would not be accurately represented.

The six principles of chaos theory and the four principles of complexity theory selected in this thesis are descriptive but not dependent upon mathematical equations in their application. They are also broad enough in scale that combined they capture the essence of a complex system. Lastly, each principle can each stand alone in a comparison to the factors of ethnic conflict.

Ethnic Conflict

With a renewed emphasis on human rights in US foreign policy, the analysis of ethnic conflict has become quite trendy in the last decade. An examination of the research pertaining to the common patterns found in ethnic conflict helps to identify these patterns. The three most important works for this thesis in identifying factors of ethnic

conflict are the 1995 and 1998 State Failure Task Force reports, the Baker and Weller study, and the Rand study on anticipating ethnic conflict.

The State Failure Task Force 1995 and 1998 reports by Ted R. Gurr and others, funded by the US Central Intelligence Agency, are comprehensive studies of the factors associated with state collapse. The task force analyzed historical data on state failure collected from 1955 to 1996 and compared it to seventy-five variables that had joint characteristics with states that had or are suffering from collapse. They then simplified their model by narrowing the factors to only three variables: "the level of material living standard (as measured by infant mortality), the level of trade openness, and the level of democracy" (Esty 1998, 1). From this model, the task force was able to predict with two-thirds accuracy those states likely to suffer political collapse two years in advance of the event.

In analyzing the structure of government, the task force used the three categories of full democracy, partial democracy, and autocracy. Of the three, partial democracies were considered the most susceptible to state failure. The studies demonstrated that partial democracies are eleven times more likely to suffer from political crises than autocracies.

Although the task force could not find any direct correlation between environmental degradation and state failure, environmental change was linked to influences in the quality of life, measured by infant mortality, and therefore contributed to the model in determining the potential for state collapse. In addition, because of the correlation of international trade to state failure, the task force concluded that policies promoting trade openness are likely to decrease the likelihood of state collapse.

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The task force reports are of most significance for this study because of the variables and methods they used in analyzing state failure. Although three variables and a two-year prediction window is sufficient for identifying those states likely to suffer a political crises, it lacks the detail needed by the political and military community on how and where to affect the problem. The task force narrowed their original seventy-five variables to fifteen key variables in analyzing ethnic conflict. In addition, they developed a special indicator set for Sub-Saharan Africa. This middle ground of factors is of value in comparing the factors of ethnic conflict with the principles of chaos and complexity theory.

Using other studies, such as Barbara Harff's "Early Warning of Genocide: The Cases of Rwanda, Burundi, and Abkhazia," (1996) the State Failure Task Force identified accelorators, de-accelerators, and triggers of conflict. In addition, the methods of analysis used in the study--logistical regression, neural network analysis, and genetic algorithm analysis--are also of importance in this study. Neural networks, like those used in the study of ecology, have been used in the study of complexity theory.

Another important study for this category is Pauline Baker and Angeli Weller's *An Analytical Model of Internal Conflict and State Collapse: Manual for Practitioners* (1998). Baker and Weller introduced a model that tracks a conflict through five stages, concluding at stage five: constitutionalism or chaos. Baker and Weller also discussed the top twelve indicators for state failure. The combination of variables and methods in the State Failure Task Force reports and Baker's analytical model and indicators serve as a foundation for determining if chaos and complexity theory can be applied to ethnic conflict.

Lastly, the Rand study entitled *Anticipating Ethnic Conflict* (1997) by Ashley Tellis, Thomas Szayna, and James Winnefeld provides a guidebook and method for intelligence analysts to predict ethnic conflict. In a three-stage process--the potential for strife, transforming potential strife into likely strife, and from likely to actual conflict--the study analyzed the roots and causes of ethnic conflict. Combining complexity theory with this study may provide insight into in determining how interrelated factors adapt on each other of which the synergistic effect explodes into conflict.

Ethnic conflict is as old as the Tower of Babel, and so published works pertaining to specific ethnic conflicts are by far the most extensive of the three categories. Although this paper cites examples of ethnic conflict throughout the world, it primarily focuses on Rwanda, Bosnia, and Abkhazia. Published works on the conflict in Rwanda include the *Rwanda Crises: History of a Genocide* (1995) by Gerard Prunier *and Rwanda and Genocide in the Twentieth Century* (1995) by Alain Destexhe.

The Balkans has received a great deal of attention over the past ten years. Two important works are *The War in Bosnia-Herzegovina: Ethnic Conflict and International Intervention* (1999) by Steven Burg; and *Yugoslavia: Death of a Nation* (1997) by Laura Silber and Allan Little. Major Michael LaChance's thesis entitled "Ethnic Flashpoints: Yugoslavia's Ethnic Indicator" (1995) introduced a model and a mathematical derivative in determining the flashpoint: the point where an ethnic conflict turns violent. Lastly, the author's 1994 Master's thesis entitled "Ethnic Conflict in the Caucasus: The Abkhaz Case" is also used. Each of the categories in the literature review build upon each other in the analysis of ethic conflict: defining chaos and complexity theory, establishing the

variables of ethnic conflict, and then providing specific examples of ethnic conflict in the world today.

This thesis uses three research studies as the foundation for determining the factors of ethnic conflict pertinent to this study. The three sudies are the 1995 and 1998 State Failure Task Force reports, the Baker and Weller (1998) study, and the Rand (1997) study on anticipating ethnic conflict. Each of these studies used a different methodology in its assessment of the factors of ethnic conflict. In addition, although the titles and the number of factors are different when one looks at the definitions of each, one can see that the areas analyzed for determining state failure are quite similar in each of the studies. The difference is the level of detail in the analysis between the studies. The three studies are listed below in ascending order of detailed analysis in determining state collapse.

The 1995 and 1998 task force reports used factors that are more quantifiable, depending less on subjective methods in determining the value of each factor. This method has the advantage of allowing one to analyze this basic information to determine if a state has the potential of collapse. However, as stated in these studies, the task force methodology is not conducive to a more detailed analysis beyond a general two-year prediction of a potential state collapse. The task force reports listed three main factors in determining a state's viability. These factors are:

1. Material Standard of Living as measured by infant mortality.

2. Trade openness as measured as a function of imports and exports compared to the gross domestic product.

3. Level of democracy divided into autocracy, partial democracy, or democracy.

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The state failure task force also narrowed their numerous indicators of state collapse down to fifteen factors. These are:

1. Infant mortality. Measures the number of deaths of infants under one year per thousand live births. Infant mortality is an indication of a country's economic performance, education, social welfare, and environmental quality.

2. Trade openness. A measure of the ratio between the value of imports and exports divided by the country's gross domestic product (GDP). It is also an indirect measure of the quality of the country's lines of communication (LOC) and population size.

3. Level of democracy. A measurement of the country's competitive political system and governmental checks and balances. It indirectly measures a country's civil and political liberties and economic health.

4. Regime durability. A measure of the length of time between the last major disruption or change in the regime. Peaceful changes do not count. It is also an indirect measurement of a country's economic health.

5. Youth bulge. A ratio of the population between fifteen to twenty-nine year age bracket and the thirty to fifty-four year age bracket. It indirectly measures a country's economic development and education.

6. Ethnicity of ruling elite. A measurement of the ethnic composition of the ruling elite as compared to the population as a whole.

7. Change in GDP. A measurement in a recent change in material welfare.

8. Level of urbanization. A measurement of the proportion of the total population that is living in cities of one hundred thousand inhabitants or more.

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9. Colonial heritage. A comparison of the impact of French colonialism on the country as compared to other country's previously under French rule. The task force only measured French colonial heritage. As such this indicator obviously does not apply to all country's including those without colonial heritage or those previously under Britain, France, German, Italy, Belgium, or Portugal rule.

10. Ethnic discrimination. Information on present or past ethnic or religious groups that suffered discrimination by dominant groups. The minority group may be one that is or did previously hold or sought autonomy within the state.

11. Land burden. The measurement of the number of farmers per unit of cropland multiplied by the ratio of farmers to the total number of workers. This measurement is highest in countries that are dependent upon agriculture, but arable land is limited.

12. Deforestation rate. A measurement of the rate of change of forested land.

13. Telephones per capita. A measurement of the total number of telephone lines divided by the country's total population. It is an indirect measure of the government's resourcefulness, GDP, and ability to react to crises situations.

14. Soil degradation. A measurement of the severity and extent of soil degradation. It can indicate a potential for a food crises for country's dependant on subsistence farming. It is also an indication of a government's ability to manage its natural resources and education.

15. Population dependent on subsistence agriculture. A measurement of the degree in which the country's population is vulnerable to deforestation or soil

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degradation. Subsistence agriculture is reflection of a country with a low per capita income and heavily dependant upon the health of terrestrial ecosystems.

The Baker and Weller (1998) study listed twelve factors to determine the potential of state collapse. These twelve factors are a balance of quantifiable areas of measurement and subjective areas of measurement, allowing for a more detailed analysis of the potential for state collapse. The twelve factors are:

1. Mounting demographic pressures. This area includes pressures from high population density relative to food supply; group settlement patterns that affect participation in economic productivity, travel, social interaction, and religious worship; land disputes to include border disputes, ownership of land, control of religious sites, and proximity to environmental hazards; and youth bulge.

Massive movement of refugees or internally displaced persons (IDPs) creating complex humanitarian emergencies. Movement of large communities because of random or targeted violence, food shortages, disease, land competition, and poor environmental conditions.

3. Legacy of vengeance-seeking group grievance or group paranoia. Includes a history of aggrieved groups because of past injustices that may date back centuries; atrocities committed with impunity against another group; governmental exclusion, persecution, or repression of groups; and public scapegoating.

4. Chronic and sustained human flight. Includes the voluntary emigration of the productive members of a society, a "brain drain" of the professionals and intellectuals, and growth in numbers of country nationals living outside the country.

5. Uneven economic development along group lines. Includes real or perceived inequality in the areas of education, jobs, and economic status.

6. Sharp or severe economic decline. Includes severe or a pattern of economic decline, a rise in poverty levels and business failures, a drop in commodity prices and foreign investment. It also includes an increase in corruption and illicit transactions in the general populace, an increase in illicit organized activity to include drug trade and smuggling, and a failure in a government's ability to pay civil and military salaries and maintain pension plans.

7. Criminalization or deligitimization of the state. Includes large-scale corruption within the ruling elite and governmental resistance to transparency and accountability. It also includes widespread confidence in the government, mass demonstrations, and armed insurgencies.

8. Progressive deterioration of public services. A decline or disappearance of basic state functions including protection, education, health, public transportation, and sanitation.

9. Suspension or arbitrary application of the rule of law and widespread violation of human rights. This area includes an emergence of authoritarian or military rule, the suspension or manipulation of constitutional rights with abuse of legal, political and social institutions, politically motivated violence against innocent civilians, and a rise in the number of political dissidents persecuted without due process.

10. Security apparatus operates as a state within a state. An emergence of a police force that acts with impunity, a faction within the military that serves the interests of the ruling elite, and an emergence of guerrilla forces or private armies.

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11. Rise of factionalized elites. This area includes a division in the ruling elites along ethnic lines and the use of nationalistic political rhetoric with negative undertones.

12. Intervention of other states or external political actors. The presence of military or para-military organizations from external armies, states, and identity groups that are engaged in the internal affairs of the state and are affecting the internal balance of power or the resolution of the conflict (Baker and Weller 1998, 21-23).

The Rand study listed three main factors or characteristics in determining the potential for strife and five main factors in determining the potential for mobilizing a group for political action. The first three factors listed below are those designed to determine the potential for strife. In each of these factors, one must analyze the existing distribution of power, wealth, and status and the relative ease with which individuals can access these through peaceful means. These eight factors are the most detailed of the three studies. These require a heavy emphasis on subjective analysis because the study recognizes not only the importance of each of the factors but its relationship to all of the others as well. The factors in determining the potential for ethnic strife are:

1. Political system. This area includes "all maters of governance, administrative control, and command over the means of coercion" (1997, 9).

2. Economic system. This area includes "all matters connected with the production of wealth and the distribution of resources" (9).

3. Social system. This area includes "all matters connected with effective claims on social esteem, including the distribution of status and social privileges" (9).

By looking at the political, economic, and social system of a country, one may determine if individuals are deprived access to such areas based on race, religion,

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language, or culture. One may also determine the level of disproportion, and the potential for peaceful change and the potential reaction of the ruling elite to such change. The five factors in determining the potential of mobilizing a group for political action are:

1. Incipient changes in the balance of power. This area includes changes in the balance of power either from long-term trends or sudden alterations. These changes can be positive or negative, and disproportionate according to group.

2. Galvanizing or tipping events. These events are "Any conspicuous public events that galvanize group sensibilities, reinforce beliefs in their insular identity, and set off escalating spirals of mutual expectations about collective resistance to the established order" (12).

3. Leadership. In this aspect leadership is in the form of identity entrepreneurs. These are individual who find it advantages to mobilize groups for political action primarily for the purpose of personal gain.

4. Resources. This area includes the ability of a group to organize and its access to support.

5. Foreign assistance. Although this area can be assessed as a subfactor of a group's access to resources, it is separate because it takes an internal conflict and makes it an interstate matter with the introduction of an external actor.

An argument can be made that an understanding of each of the factors listed above and their relationship to each of the others is important in the comprehension and application of chaos and complexity theory to the analysis of ethnic conflict. However, it is not within the realm of this study to develop a new interpretation of ethnic conflict and its factors, and then apply these to the principles of chaos and complexity theory with the

goal of developing some type of ethnic conflict complexity model. This thesis only needs to determine if the principles of chaos and complexity theory can help explain ethnic conflict. Therefore, the author summarized from these three lists five factors to compare to the six principles of chaos theory and the four principles of complexity theory.

Using conceptualization and synthesis, the author compared the various factors in three studies. First, similar factors were combined. Second, the factors were then narrowed to five initially considered comparable to the principles of chaos and complexity theory. As stated, the five factors chosen are a somewhat conglomeration of the thirty-eight factors listed in the three studies above. The factors of ethnic conflict chosen for further analysis and comparison to chaos and complexity theory are:

1. Identity entrepreneurs. This area includes the state failure task force factor of ethnicity of the ruling elite. It also includes the Baker and Weller factor of rise of factionalized elites. Identity entrepreneurs are individuals that take advantage of a situation using the religious, nationalist, or ethnic card to solidify the masses into a movement for the underlining purpose of increasing self-gain. These individuals "for self-interested reasons, find it profitable to contribute to creating group identities and bear the costs of mobilizing such groups for political action" (Rand 1997, 92).

Throughout the world there are ethnic groups who are subjected to severe discrimination, but are not considered a problem in terms of internal stability. They are not a problem because these subjugated masses have yet to coalesce into one identity, or if they have, a catalyst has not been injected into the group to push them into action.

Identity entrepreneurs serve as the catalyst to both coalesce groups and spur them into action.

On April 24, 1987 when he told an angry crowd of Kosovo Serbs, "No one should dare to beat you," Slobodan Milosevic became an identity entrepreneur (Silber and Little 1997, 37). Some political analysts trace the entire rise of modern Serb nationalism and the events leading to the fall of the former Yugoslavia to Milosevic's fateful visit to Kosovo in April of 1987, and at first Milosevic did not even know what he had started. However, as a career politician, he realized the power potential of nationalism and quickly seized it.

> Milosevic understood what it meant. For the first time he saw that an angry crowd could unsettle the Yugoslav leadership. He turned to [Ivan] Stambolic and said: "The fatherland is under threat." Stambolic was astounded and asked what the matter was. He saw that Milosevic was shaking. It struck Stambolic as a decisive alarming moment. "And that's how it all began. The nationalist ran into his embrace. They grabbed him. He didn't reallly enjoy it very much. But he knew that it was politically very profitable." (Silber and Little 1997, 40)

Identity entrepreneurs cannot by themselves spur an ethnic group into action. Interrelationships with other elements upon the ethnic group have to make the situation ripe for change. The identity entrepreneur serves as the catalyst.

> The resentments created by this initial imbalance of power set up an oscillating dynamic of reaction and counter-reaction--Albanian reaction to the Slavs after 1966, and Slav counter-reaction in the 1980s--which made Kosovo's internal politics all the more bitter in intractable. Nor should it be forgotten that it was Tito's legacy of stultified political system and a collapsing economy that created the conditions under which a politician such a Slobodan Milosevic could rise to power and manipulate Serbian nationalism to his own destructive advantage. (Malcolm 1998, 314)

2. Ethnic discrimination. This area includes the Baker and Weller (1998) factors of legacy of vengeance-seeking group grievance or group paranoia and uneven economic

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development along group lines. It also includes the Rand study factors of social system and economic system. Ethnic discrimination as a factor of ethnic conflict would seem to be a no-brainer: one has to have ethnic discrimination in order to have ethnic conflict. However, this is not always the case. A conflict can arise for other reasons with the perception of ethnic discrimination percolating up to become the number one solidifying factor, even though there is no historical precedent of ethnic discrimination against the group.

The term ethnic discrimination encompasses many facets. It can include political discrimination, economic discrimination, or informational discrimination. It also encompasses the historical legacy of discrimination, whether real or perceived, of an ethnic group. This is the first facet of ethnic discrimination that this thesis addresses. A cyclic history of ethnic discrimination, combined with other factors to include indications that the group will again suffer because of its ethnic identity can act as a coalescing factor. This was the case for the Abkaz in the early 1990s.

Abkhazia lies in the northwest section of the old Soviet Union Georgia. Dating back to the eighth century, the Abkaz people have suffered through a cyclic history of independence followed by subjugation and ethnic discrimination. In the seventeenth-century, Abkhazia broke away from Georgia to become a separate vassal under the Ottoman Empire. In 1810, Abkhazia broke from the Ottoman Empire to Tsarist Russia. During the dates 1864-1866, 1918, 1931-1938 the Abkhaz people suffered ethnic discrimination, either from the Russians or the Georgians, to include massive forced migrations, religious persecution (the Abkhaz are Muslim), and cultural persecution (it became illegal to teach the Abkhaz language). These periods of ethnic discrimination

were interspersed with periods of ethnic healing and Abkhazian independence or autonomy. As Georgia broke away from the old Soviet block in the early 1990s, a cry of Georgian nationalism, meaning ethnic Georgians, rang out.

Tipping events, discussed below, that occurred in Abkhazia and Georgia signaled to the Abkhazian people that a new wave of ethnic discrimination by the Georgians upon the Abkhaz would begin. It was because of an historical precedent of attempts by outside actors to eliminate the Abkhaz race that the Abkhazians were able to deduce from the tipping events that another round of ethnic discrimination would begin, and the Abkhazians again feared ethnic annihilation. This fear coalesced the Abkhazians into an active force.

Besides an historical precedent, current acts of ethnic discrimination can solidify an ethnic group into action. These acts can generally be divided up into political, economic, or informational discrimination. Just as one saw Milosevic play the nationalist card in his rise to political power, so did Zviad Gamsakhurdia when he became president of Georgia in the early 1990s. Gamsakhurdia's nationalist party, composed entirely of ethnic Georgians, prevented the ethnic minorities in Georgia from having any voice in the government. The Georgian government maintained absolute control over all the media. Without a peaceful means to voice their concerns and perceiving that their ethnic identity was being threatened, violent actions became the only remaining act of self-preservation.

3. Tipping Events. These are events that serve as catalysts to galvanize a group's identity to the point of political action.

> Tipping events are simply any conspicuous public events that arouse group
> sensibilities, reinforce beliefs in their insular identity, and set off escalating spirals
> of mutual expectations about collective resistance to the established order. By

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their occurrence, the "confirm or justify the [latent] fears or hatreds in [to] a [more] generalized belief; they may initiate or exaggerate a condition of strain; or they may redefine sharply the conditions of conduciveness [leading to future mobilization and violence]." Tipping events can take different forms. They could include large-scale public violence directed at members of a community, the forcible relocation, banishment, exile, or execution of important or numerous individuals in a community, or any other such conspicuous event that induces or reinforces a differential perception of vulnerability. (Rand 1997, 91)

The assassination of Archduke Francis Ferdinand in Sarajevo in 1914 initiated a series of events that led to World War I. Milosevic's trip to Kosovo in April 1987, described above, coalesced the Serbian people down a path of ethnic nationalism. Georgia provided the ethnic Abkhaz in Abkhazia a few tipping events of its own.

In the summer and fall of 1992, two tipping events occurred in Abkhazia, which spiraled that strife down the path of ethnic conflict complete with acts of reprisal and acts of atrocity that serve as examples for this paper. The first tipping event occurred in August 1992. The commander of the Georgian State Council troops in Abkhazia went on Abkhazian television with an ultimatum to the separatists Abkhazians. He promised "to leave the entire Abkhaz nation without descendants" and to "sacrifice 100,000 Georgians to annihilate [the] 97,000 Abkhazians," the approximate number of Abkhazians living in Abkhazia (Current 1994, 25). Although the context in which these statements were made is still in question, of importance is the fact that the Abkhazians believed that these statements were made and perceived as a genocidal threat (Current 1994, 26).

The second tipping event occurred in October 1992 when the Georgian forces burned the Abkhaz Institute of Language and Literature of Sukhumi. This building was not only the historical museum of the Abkhazian people, it also housed all the birth records of the Abkhazians. Its burning meant the losses of any historical works on the

Abkhazian culture and all the family records that testified to a distinct Abkhazian race. Its burning erased the written Abkhazian ethnic identity. The Abkhazians then perceived their death to be only one historical revisionist away.

4. Governmental structure. This area encompasses the state failure factors of regime durability, ethnicity of ruling elite, and level of democracy. It encompasses the Baker and Weller (1998) factors of criminalization and/or deligitimization of the state and suspension or arbitrary application of the rule of law. It also encompasses the Rand factors of political system, social system, and change in power.

Governmental structure encompasses the institutions of the state. It encompasses the laws governing language, citizenship, and religion. The government determines what will be written in the history books and what will be taught in the public schools. History, or sometimes revisionist history, and folklore are very important in forming the psychic of the ethnic population.

In the late nineteenth-century, identity entrepreneurs began embellishing the history surrounding the defeat of Serbian Prince Lazar in 1389. Relying more on folklore than fact, this version of history created the Serbian ethos that some would say is the root of the problems facing the Balkans today.

> The idea that this folk-poetic tradition supplied the essence of a special type of historical-national self-consciousness for the Serbs is, in fact, a product of the nineteenth century. It is nationalist writers and nation-builders such as Vuk Karadzic (the influential early-nineteenth-century folksong collector and dictionary writer) and Petar Petrovic Njegos (the poet and princely ruler of Montenegro, whose famous epic poem, the *Mountain Wreath*, was published in 1847) who took the elements of the popular Kosovo tradition and transformed them into a national ideology. (Malcom 1998, 79)

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Language is also a defining part of the distinctiveness of an ethnic group, and it is one area that a government, through its institutions, can change over a relatively short period in order to create a new identity. When the Dayton Accords were signed in 1995, Serbo-Croatian, the language spoken by both Serbians and Croatians, was the language. Since the signing, Croatia has slowly been changing its language. The Croatians living in Bosnia have dual citizenship, so they too have been changing. The Croatian, Serbian, and Bosniac children in Bosnia already attend separate schools that teach different versions of history. By the time the next generation matures, these groups will be separated by language as well.

A weak governmental structure can be just as destabilizing as a strong nationalistic one. As outlined above, during the rise of Gamsakhurdia, he took advantage of cracks in the then failing Georgian government. A peaceful demonstration on 4 April 1989 calling for an independent Georgia led to a governmental crackdown. On that day, later to be known as Bloody Sunday, nineteen people were killed, mainly women and children. Failure of the government to protect its citizens left them looking somewhere else. That is when Gamsakhurdia stepped into the picture. This same type of failure in the Serbian government to protect ethnic Serbians in Kosovo during the late 1980s is what brought Milosevic to power.

The current ecological disaster facing Mozambique is a good example of the importance of governmental structure in preventing state failure. Eight years after a peaceful resolution to a decades old civil war, Mozambique was finally getting back on its feet. For the first time in years, it appeared that the country would be able to feed itself from internally grown subsistence crops, and the country was considered by the

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international community to be an African success story. The flood not only threatens the country's economic health; it threatens the fledgling government's existence as well.

Frelimo factions, the main political opposition within Mozambique, along the northern parts of the country are rising again in the midst of the receding waters. Many of Mozambique's population are very unhappy with the government's perceived lack of urgency or response during the resent flooding. Rumors of corruption within the government to include the selling of the country's helicopter parts and a lack of maintaining the helicopters that were desperately needed to rescue citizens and provide logistically support to isolated areas. The lack of the government's ability to provide rescue support, clean water, and medical supplies has equated to countless lives being lost. Disillusioned with the current regime, the populace may seek guidance elsewhere. Mozambique's current flood is also a good example of how mounting demographic pressures, discussed next, can cause a country to fall into state collapse.

5. Mounting demographic pressures. This area includes from the task force report the factors of trade openness, youth bulge, level of urbanization, land burden, soil degradation, deforestation rate, and the population dependant on subsistence allowance. It also includes from the Rand study the factors of the social system and the economic system.

Mounting demographic pressures are those pressures derived from a high dependence on the terrestrial ecological system, youth bulge, access to historical or religious sites, and ease of access to economic systems. Mounting demographic pressures, especially when combined with a decline in governmental structures as outlined in the Mozambique example, allow identity entrepreneurs to galvanize groups

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who are discontent with their current situation in life. This area is the foundation for Robert Kaplan's idea of perceived relative deprivation (PRD). Edward Maney describes PRD,

> The importance of the word relative is that the goods or conditions of life Gurr refers to as values are different depending o one's standing in a particular society and in one society versus another. In a traditional rural society, the values of importance to the peasant are essentials of life such as food, shelter, and basic health needs along the lines of the first level in Maslow's hierarchy of needs. However, as one moves up the hierarchy, the individual views values such as status, power and prestige as more important. (1999, 1)

The five factors selected in this study--identity entrepreneurs, ethnic discrimination, tipping events, governmental structure, and mounting demographic pressures, encompass the factors listed in the Baker and Weller study (1998), the Rand study (1997) and the 1995 and 1998 State Failure Task Force reports. Table 1 below lists the five ethnic conflict factors selected and those factors from the three studies that fall under each of them. Although some areas have been listed under tipping events, it should be understood that any change in the elements listed below could act as a tipping event. It should also be noted that some of the factors are listed under more than one of the five factors chosen. This duplication is the result of the author of this thesis trying to match the selected five factors with the intent of the other factors from the three studies.

The five factors of ethnic conflict chosen for this study were selected for two reasons. First, five is a small enough number to be manageable within the scope of a thesis. Second, as illustrated in table 1, these five factors include a broad enough area to cover the entire system that gives rise to ethnic conflict.

Table 1. Factors of Ethnic Conflict

Factors	Task Force studies	Rand study	Baker and Weller
Identity Entrepreneur	Ruling elite	Leadership Resources	Factionalized elite
Ethnic Discrimination	Colonial Heritage Violation of human r. Ethnic discrimination	Human flight	Legacy Uneven econ. dev. Rule of law
Tipping Events	Change in GDP	Change in Power Tipping events	Rule of Law Human flight Sharp econ. decline
Governmental Structure	Regime durability Ethnicity of elite Level of democracy Telephones per cap. Colonial heritage Trade openness	Political system Social system Change in power Leadership Foreign assistance	Crim./del. of state Rule of law Refugees Security apparatus Factionalized elite Ext. political actors
Mounting Demographic Pressures	Trade openness Youth bulge Level of urbaniz. Land burden Soil degradation Deforestation rate Pop. dep. on subsist. crops Infant mortality Change in GDP Telephones per cap.	Social system Economic system Resources Foreign assistance	Human flight Det. of public serv. Mounting demogr. pressures Refugees Uneven econ. development Sharp econ. decline Ext. political actors

Identity entrepreneurs and ethnic discrimination encompass the ethnic group in question. Governmental structure includes the state's behavior towards an ethnic group

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and the state's ability to cope with crises. Mounting demographic pressures have the potential to create friction between the ethnic group, other groups, and the government. Lastly, tipping events can occur throughout the system, accelerating interactions and feedback beyond the point where elements can cope with change. The factors of identity entrepreneurs, ethnic discrimination, governmental structure, and mounting demographic pressures and their relationships with each other are what constitute the ECCM used in chapter 4. Tipping events permeate each of the other four factors individually and the ECCM as a whole.

Through the analysis of these five factors and their relationship to the others one may determine if a country is susceptible or is in the process of state collapse. A country who's government is unable to cope with mounting demographic pressures and that closes itself off from public scrutiny or access from portions of the population, is vulnerable to potential identity entrepreneurs who have the ability to galvanize the aggrieved masses into political action. The negative aspects of these five factors can feed upon each other and spiral a country down a path of state collapse and chaos.

<div align="center">Conclusion</div>

Through conceptualization and synthesis, chapter 2 narrowed the principles of chaos theory to six, the principles of complexity theory to four, and the thirty-eight factors of ethnic conflict to five. The six selected principles of chaos theory are chaos is a deterministic process, it happens in feedback systems, it is self generated, the ranges have finite variables, it is hypersensitive to initial conditions, and it may have fractal properties. The four selected principles of complexity theory are self-organization and emergent properties, adaptation or co-evolution, disproportionate effects, and sensitivity

to initial conditions. The five selected factors of ethnic conflict are identity entrepreneurs, ethnic discrimination, tipping events, governmental structure, and mounting demographic pressures.

Chapter 3 discusses the qualitative research methodology and the three phases of analysis used in this thesis. In chapter 4 each of the five factors of ethnic conflict is compared to a selected principle of chaos or complexity theory to demonstrate the value of nonlinear theories in the analysis of conflict. In addition, in chapter 4 a little time is spent evaluating the dynamics between the five factors of ethnic conflict and their relationship to the theories of chaos and complexity theory as a whole.

CHAPTER 3

RESEARCH METHODOLOGY

We live in a world orderly enough that it pays to measure.

Paul Johnson (Czerwinski 1998, 29)

Introduction

This thesis uses qualitative analysis for the purpose of answering the primary research question. Information is first collected and categorized according to the three literature categories. As detailed in chapter 2, these literature categories are: research pertaining to the principles of chaos and complexity theory, research pertaining to the common factors found in ethnic conflict, and research pertaining to specific ethnic conflicts. These categories of literature are then applied to the three phases of analysis. Each phase of analysis corresponds to a secondary research question introduced in chapter 1.

The sections below outline each phase of analysis. Each section describes what is to be accomplished in that phase of analysis, what secondary research question is answered and what category of literature the phase will draw upon. The three phases of analysis are:

1. Phase I: The principles of chaos theory and complexity theory (conducted in chapter 2).

2. Phase II: The common factors of ethnic conflict (conducted in chapter 2).

3. Phase III: The applicability of chaos and complexity theory in analyzing ethnic conflict (conducted in chapter 4).

Analysis Phase I

Analysis phase I, the examination of chaos and complexity theory, answers the first secondary research question by defining the principles of chaos and complexity theory. Analysis phase I is divided into two parts. Part I, the literature review of chaos and complexity theory, of phase I is not analytical, but builds a frame of reference for part II. Literature category I, research pertaining to the principles of chaos and complexity theory, is of primary importance for this phase of analysis.

Based on the literature review in part I, part II, the relationship between chaos and complexity theory, analyzes the principles of chaos and complexity theory. Using qualitative analysis, this thesis narrows, defines, and then examines six principles of chaos theory and the four principles of complexity theory for the purpose of later comparing these to the five chosen factors of ethnic conflict. For example, the complexity theory principle of punctuated equilibrium is defined as a relatively stable system that undergoes a rapid and significant restructuring because of an accumulation of factors. When comparing it to ethnic conflict, punctuated equilibrium demonstrates a potential application to help explain the crises in 1991-1995 Bosnia, 1994 Rwanda, and 1993-1994 Abkhazia.

In this narrowing of chaos and complexity principles, qualitative analysis is used to determine which principles are common to a variety of research works that combine chaos and complexity theory. The purpose of this qualitative analysis process is to match authors' intent. Since chaos theory and complexity theory are still in their infancy, the principles examined in two research projects may be the same even though the

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terminology used is different. For example, one author may refer to lever points the same way that another author describes accelerators and de-accelerators.

Analysis Phase II

Analysis phase II, the analysis of common factors found in ethnic conflict, answers the second secondary research question: what common agents, interactions, or patterns are found in ethnic conflict? This phase of analysis draws upon literature category II: research pertaining to the factors of ethnic conflict. Phase II is divided into two parts.

Part I is a literature review of the factors found in ethnic conflict. Part I first discusses the various works on ethnic conflict. It then concludes by listing the factors of ethnic conflict described in the 1998 State Failure Task Force report, Pauline Baker's ethnic conflict analytical model, and the Rand study on ethnic conflict. For a more detailed description of these three works, refer to chapter 2.

Part II is a narrowing and defining of the factors of ethnic conflict that are applied to chaos and complexity theory. The narrowing of factors is primarily because of the limitation of time. However, the comparison of five factors is adequate for this study in determining the applicability of chaos and complexity theory to the analysis of ethnic conflict.

Analysis Phase III

Analysis Phase III, the utility of chaos and complexity theory in analyzing ethnic conflict, answers the third secondary research question: what is the utility of chaos and complexity theory in analyzing ethnic conflict? Phase III utilizes the qualitative research

methodology. Phase III first compares the list of chaos and complexity principles presented at the end of phase I with the factors of ethnic conflict presented at the end of phase II to determine if chaos and complexity theory can be utilized in the analysis of ethnic conflict.

Conclusion

As described above, this thesis attempts in its research methodology to nest the tertiary research questions, the phases of analysis, and the literature categories under each of the secondary research questions. This nesting is for the purpose of providing a systematic approach in answering the primary research question. Analysis phases I and II build the base for the analytical process by defining the principles of chaos and complexity theory and the factors of ethnic conflict. These two phases are covered in chapter 2. Analysis phase III is covered in chapter 4. Conclusions and recommendations for further study are then covered in chapter 5.

CHAPTER 4

ANALYSIS

> Obviously, this is an act of imagination. Things are perceived. Of course, partly by the naked eye and partly by the mind, which fills the gaps with guesswork based on learning and experience, and thus constructs a whole out of the fragments that the eye can see (Clausewitz 1984, 109).

Introduction

Chapter 4 is divided into seven sections. The first section, the introduction, reviews the two previous phases of analysis discussed in detail in chapter 2 and the methodology of analysis phase III for this chapter. Section one also introduces the model used in this chapter and lists the selected factors of ethnic conflict and principles of chaos and complexity theory from chapter 2. Section two of this chapter discusses in some detail the model developed for use in analysis phase III. In sections three through six, each section compares a different principle or principles of chaos and complexity theory with the factors of ethnic conflict. The last section, conclusions, summarizes the findings of chapter 4.

Building on the first two phases of analysis in chapter 2, chapter 4 covers analysis phase III. In chapter 2, analysis phase I first examines the research being conducted in the field of chaos and complexity theory. Second, analysis phase I defines the principles of chaos and complexity theory and, lastly, it summarizes those principles that continue to the phase III.

Analysis phase II first examines the research being conducted in determining the common factors of ethnic conflict. From three selected research works, phase II then defines the factors of ethnic conflict and, lastly, narrows the list of factors to those that

continue to analysis phase III. Chapter 4 combines the principles of chaos and

complexity theory from analysis phase I with the factors of ethnic conflict from analysis

phase II for the purpose of answering the last secondary research question: what is the

applicability of chaos and complexity theory in analyzing ethnic conflict?

The factors of ethnic conflict and the principles of chaos and complexity theory

listed below are those that were determined in analysis phases I and II in chapter 2 to be

pertinent for examination in analysis phase III.

Table 2. Factors of ethnic conflict and principles of chaos and complexity theory

Ethnic Conflict	Chaos Theory	Complexity Theory
1. Identity Entrepreneurs	1. Deterministic	1. Self-organization / Emergent properties
2. Ethnic discrimination	2. Feedback systems	2. Adaptation or co-evolution
3. Tipping events	3. Self-generated	3. Disproportionate effects
4. Governmental structure	4. Finite variables	4. Sensitivity to initial conditions
5. Mounting demographic pressures	5. Sensitivity to initial conditions	
	6. Fractal properties	

Chapter 4 utilizes an author-designed ethnic conflict complexity model (ECCM)

in its examination of the applicability of the principles of chaos and complexity theory to

the analysis of ethnic conflict. This model was designed for this purpose. Although a

good tool for mental mapping, this model is still limited in its ability to explain ethnic

conflict in general. A far more detailed model in some future study would be better

suited for that purpose.

The ECCM contains the ethnic conflict factors of ethnic discrimination, governmental structure, mounting demographic pressures, and identity entrepreneurs. This paper compares the factors of ethnic conflict in the ECCM with the chaos and complexity theory principles of self-organization and emergent properties, adaptation or co-evolution, feedback, and disproportionate effects in sections three through six, respectively. Although not depicted in the ECCM, the ethnic conflict factor of tipping events is discussed in section six. As detailed in chapter 4, tipping events can occur within each of the other factors of ethnic conflict or within the ECCM as a whole. Thus, tipping events are examined in reference to how they affect the other factors of ethnic conflict and, specifically, their relationship to the chaos theory principle of disproportionate effects.

Table 3 below lists the principles of chaos and complexity theory that are compared to the selected factors of ethnic conflict in sections three through six.

As illustrated in table 3, in sections three through six each of the selected chaos and complexity theory principles is examined in relation to a different factor of ethnic conflict, to two or more factors, or to the ECCM as a whole. A fictitious example of an ecological disaster is then superimposed onto the model to demonstrate the relationship between the principle of chaos and complexity theory examined in that section and the factors of ethnic conflict in the ECCM. Lastly, the events of a previous ethnic conflict may also be superimposed on the model for the purpose of demonstrating this relationship. Phase III utilizes the events in Abkhazia and Georgia during the early 1990s as the example of ethnic conflict.

Table 3. Correlation of examined chaos and complexity principles
and factors of conflict

Section	Principles of Chaos and Complexity	Examined Factors of Ethnic Conflict
Three	Self-organization and emergent properties Sensitivity of initial conditions Fractal properties	Mounting demographic pressures
Four	Adaptation and Co-evolution Emergent properties	Mounting demographic pressures Governmental structure Identity entrepreneur Ethnic discrimination Tipping events
Five	Feedback and finite bounds Deterministic	Governmental Structure Ethnic discrimination
Six	Disproportionate effects Feedback	Tipping events

The Ethnic Conflict Complexity Model

The Ethnic Conflict Complexity Model (ECCM) contains four of the five ethnic

conflict factors listed in table 2. These factors are governmental structure, mounting

demographic pressures, identity entrepreneurs, and ethnic discrimination. Although each

of these factors was described in detail in chapter 2, a brief review is perhaps warranted.

The first ethnic conflict factor, governmental structure, encompasses the

characteristics of government. It includes ruling elite and political and judicial systems.

It includes laws governing citizenship, language, religion, marriage, access to higher

education, and access to the economic system. It includes historians who write, or

rewrite, state history and laws that govern what will be taught in the public schools.

Lastly, it includes all state institutions.

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The second ethnic conflict factor the ECCM, mounting demographic pressures, are those areas that influence a group's perceived relative deprivation. This area includes population pressures on limited arable land, soil erosion, deforestation, natural and manmade ecological disasters, and youth bulge. The third factor, identity entrepreneurs, is those individuals that mobilize aggrieved ethnic groups for the purpose of personal gain. Adolph Hitler, Zviad Gamsakhurdia, Slobodan Milosevic, and Radovan Karadzic are just a few examples.
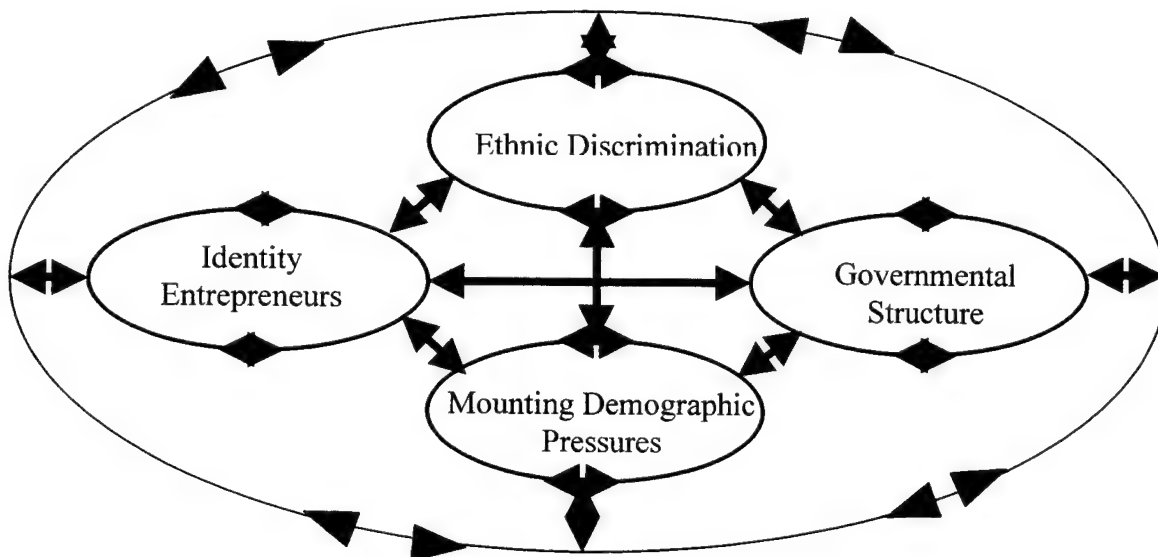
Figure 1. The Ethnic Conflict Complexity Model (ECCM)

Ethnic discrimination is the last ethnic conflict factor in the ECCM. The heart of this factor is the group that perceives itself, whether actual or not, to be the focus of organized discrimination. Galvanizing factors of this perception may originate from all of the factors associated with governmental structure: laws, ruling elite, and institutions. Mounting demographic pressures may have a significant impact upon the group as well.

It is also important to note that the perception of discrimination, or relative deprivation, may be entirely self-generated within the group, or the emergent property resulting from the interaction between the aggrieved group and an identity entrepreneur. Emergent properties are new attributes of an element that arise through interactions with other elements.

<u>Self-organization and Emergent Properties</u>

The complexity theory principle of self-organization states that interaction within an element or its interactions with other elements may lead to changes in the elements. The elements in the ECCM are the four factors of ethnic conflict. Changes in these elements may lead to a higher, more organized structure within each, or change the element's outward appearance as emergent properties arise, or change the system as a whole.

As detailed in chapter 2, self-organization can be autocatalylitic, that is originating and occurring entirely within an individual element. For example, natural disasters can be internally self-generated within the element of an ecological system. A change in the weather pattern can produce an unseasonable or a drastic increase in rainfall over a given area. The soil saturates and erosion begins. The creeks flood which then spill into the rivers, and they too flood. The river water depth exceeds the banks, and the water spills into the countryside. The water carries the nonfertile soil from the soil-eroded areas and spreads it all over the lowlands.

The nonfertile soil covers the vegetation in the lowlands to the point that it cannot quickly recover. The herbivores begin to suffer and die from famine, and the carnivores soon follow. The increase in water covered areas, combined with the numerous rotting

animals, causes an increases in disease carrying bugs like mosquitoes. Emergent

properties include famine and disease. The ecological situation described above is not

unlike what Mozambique is currently and will experience.

Examining this fictitious example, an ecologist may contest that each of the areas

described above--weather, soil, plant life, animal life, and drainage systems, are elements

in themselves within the larger ecological system. It is then the interaction between these

elements that causes the terrestrial system to change. Based on this line of reasoning, this

ecologist may conclude that it was coevolution or adaptation (covered later), not self-

organization, between elements that produced this natural disaster.

One may now appreciate the difficulty in defining an element. The ecologist

above considers all the factors listed as elements within the terrestrial system. Another

ecologist may contest that the food chain is a system in itself, wherein the different plant

and animal species are all elements within that system. This narrowing of a system and

the elements that compose it can continue down to infinitum.

For the purpose of this study, the terrestrial system is only a part of the ethnic

conflict element of mounting demographic pressures. This element also includes such

areas as youth bulge, man-made hazards, farming, and industrialization. The ecological

disaster is entirely self-generated within the element of mounting demographic pressures.

This example takes self-generation to the extreme, but slight self-generated changes

within an element have the potential of changing the entire system. Remember the

Butterfly Effect? Slight self-generated changes adjust the element's interaction with

other elements. Changes continue based on the principles of adaptation, coevolution,

feedback, and disproportionate effects. Soon the system is radically different from its original appearance.

The ecological disaster example helps demonstrate the relationship between the complexity principle of self-organization, emergent properties, and the ethnic conflict element of mounting demographic pressures. In addition, in explaining the differences between how the two ecologists' define a system, it introduces the complexity principle of adaptation and co-evolution, covered next.

<center>Adaptation and Coevolution</center>

The complexity principle of adaptation and co-evolution stipulates that during the interaction between elements, these elements may become more fit or less fit. Those that continue to become less fit fail to adapt and eventually loose their own core identity and slip into chaos. Their pieces may be absorbed into other elements within the system. Those elements that do adapt become more fit to survive. They maintain their core identity while gaining emergent properties based on their adaptations. Coevolution is a series of continued interactions and then adaptations between elements. To demonstrate the relationship between the complexity principle of adaptation and coevolution to the factors of ethnic conflict, this study first continues with the fictitious ecological disaster example, and then turns to the example of ethnic conflict in Abkhazia during the early 1990s introduced in chapter 2.

Continuing with the fictitious ecological disaster example, this paper broadens the elements examined to those in the ECCM, including not only mounting demographic pressures but governmental structure, ethnic discrimination and identity entrepreneurs as well. The interactions between these four elements help demonstrate the relationship

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between the complexity principle of adaptation and coevolution and the four factors of ethnic conflict listed. In addition, the flood is a tipping event, increasing interactions and feedback between the other four elements beyond the capacity of the system to cope with change.

The governmental structure element interacts with the element of mounting demographic pressures. The latter adapts based on this interaction. Before the rains come in the example described above, the governmental structure establishes laws pertaining to deforestation and crop planting that increase the chances that heavy rains could cause catastrophic soil erosion and flooding. The emergent property of this interaction was the soil table being less able to absorb high concentrations of water. When the rains fell, the soil went downstream and covered the lowlands. Depending on ones point of view, the ecological system has either undergone a punctuated equilibrium, evolving into a soil-eroded, barren, disease infested landscape; or it has slipped into chaos.

The subsistence crops in the lowlands are covered as well. Hungry and displaced, people turn to the government for help. In this fictitious example government, lacking the resources to help everyone, helps the people in the capital first. Within the rural area a community who may be historically different from the people living in the city or just slightly different because of language, dialect, social status, or dress, begins to believe that the government is discriminating against them. Perceived relative discrimination is the emergent property within ethnic group elements, arising from the group's interaction with mounting demographic pressures and the governmental structure.

This perceived relative deprivation might be real or imagined. In this example, government might be helping those in the capital solely because it only has the resources to project that far. The government might also be inept and unable to help anyone, including those individuals living in the capital. However, because the lines of communication were destroyed during the flood, the rural community does not know that all people are suffering equally. In fact, they might be better off than the individuals living in the capital, but because there is no means of communication, perceived relative deprivation emerges. Now enters the identity entrepreneur.

The identity entrepreneur for reasons of personal gain begins to galvanize the rural community by first describing their differences from those individuals living in the city. This person blames the government for the flooding and subsequent lack of help. Lastly, the entrepreneur motivates the rural community into taking action. Through interaction with the elements of mounting demographic pressures, governmental structure, and identity entrepreneur the ethnic group evolves into an aggrieved and active organization.

As the water recedes, the rural community lacks enough arable land to feed itself and begins to take land from others. These latter individuals are then displaced and cry to the government for help. With the water gone, the government is now able to move out into the rural area.

The government begins persecuting the rural community for taking the newly acquired lands. This persecution only feeds the rural community's delusion of organized discrimination. The identity entrepreneur continues to feed the fire as well. The rural

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community attacks government officials, leading to a second round of persecution. Lines are drawn and the situation continues to escalate.

This example helps demonstrate how interactions between elements can cause the elements to adapt and coevolve. The interaction between the governmental structure and mounting demographic pressures causes the latter to evolve, or devolve, into a barren wasteland. The interaction between the governmental structure, mounting demographic pressures, the identity entrepreneur, and the ethnic group induces the last one to continue evolving.

With each interaction, evolution or adaptation continues. The rural community proceeds down the path described above, raising its own army and openly fighting the government for control. The government, who might have had no previous inclination of discrimination when the flooding began, begins attacking the rural community. Identity entrepreneurs rise within both ranks. An emergent property from these interactions is hatred on both sides for the other. Although Abkhazia did not suffer an ecological disaster, the elements, or factors, of that ethnic conflict in the early 1990s coevolved to the point of mass violence.

For this next example, all four elements of ethnic conflict in the ECCM are pertinent, but the element of mounting demographic pressures does not play as much as of a significant role as it did in the ecological disaster example. However, some analysts may argue that it was the fight for control of Abkhazia, the land itself--a demographic pressure, not ethnic or ideological differences between the Georgian and the Abkhaz that is more responsible for the conflict. Based on this argument, mounting demographic pressures did play a significant role. However, the example below emphasizes that it was

the interaction between the Abkaz, the group within the element of ethnic discrimination, the newly formed Georgian government, and Zviad Gamsakhurdia, whom has already been identified in this paper as an identity entrepreneur, that caused the situation to erupt into ethnic conflict.

In the next example, the situation in Georgia can be compared to the area of the chaos and complexity scale known as the edge of chaos. Within this area evolution is possible. As interactions and bifurcations increase exponentially, some elements slip over the edge into chaos. However, some of the elements adapt and evolve, combining with other elements to form new and complex structures. Georgia in general by December 1993 can be described as the former, while the Abkhaz separatists during the same time could be described as the latter.

In the late 1980s as the Soviet Union began to unravel, the Abkhaz government began to seek a closer tie with Russia and independence from Georgia. Because of Bloody Sunday, described in chapter 2, the Georgians demanded the removal of pro-Russian officials from the Georgian government. Continued resentment towards Russia transformed, or self-organized, a series of aggrieved issues into a Georgian independence movement. This movement further evolved into a Georgia for Georgians movement.

> Occasionally, in informal conversations, the radicalism and hotheadedness that is under the surface inadvertently emerge. One of the young Christian Democrats asserts that "Georgia should only be for Georgians," all Soviet troops and eventually all other nationals should leave the republic. (Diuk 1990, 150)

Zviad Gamsakhurdia rode this Georgian ethnic movement to power and was elected President of Georgia. Rallies in his honor would frequently cry out, "Long live a democratic, independent, Christian Georgia" (Diuk, 150). Not going unheeded by the

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non-Georgian inhabitants, South Ossetia, another region of Georgia, continued its fight to secede and unite with North Ossetia. The indigenous Azerbaijans also demanded their own autonomous territory. The Abkhaz formed a tactical alliance with the other Muslim groups within the North Caucasus to include the Chechens, Adigei, Abaza, Ingush, Kabardian, and Cherkess.

After his election in May 1991, Gamsakhurdia reversed his preelection promise to South Ossetia of greater autonomy. The region not only lost its autonomous status, but was given a Georgian name as well. In reference to the status of Abkhazia, Gamsakhurdia cited an unofficial policy document known as the 1989 Chronicle 4, which proposed to break Abkhazia into pieces.

> All regions of Abkhazia that had a "Georgian" majority (Gali, Gulripsh, Gagr, Sukhum, and part of Ochamchira) would fall under direct control of Tbilisi. The other regions would come under the government of the Abkhaz "region." (Hewitt 1993, 287)

One unifying factor between the major political parties in Tbilisi was their treatment of the minorities, so Abkhazian attempts for a political retraction of Chronicle 4 were futile. Ethnic unrest spread though Georgia like a malignant tumor, infecting South Oseetia, Abkhazia, Adzharia, and Mingrelia. Yet the parliament in Tbilisi remained blind to its obligation and the necessity to address the grievances of the minorities.

From 1989 to 1991 Georgian nationalism went from minority assimilation to minority exclusion. A June 1991 law did not require persons currently living in Georgia to know Georgian, "although any new petitioner for citizenship would have to know the language" (Jones 1992, 83). In August, Georgia passed a law requiring the teaching of the Georgian language in all schools, and the administration of the Georgian language

and literature tests for entry into higher education. The death of the minority languages was only one generation away.

Georgia's encroachment on the autonomous regions threatened the autonomy of the ethnic minorities. The establishment of a language barrier for citizenship threatened their existence. Conflict became inevitable.

> If a group adopts an ethnic definition of its nationality, yet lives intermingled with other ethnic groups, conflict is unavoidable because the group's achievement of full statehood presupposes the denial of citizenship and protection to members of other ethnic groups. (Snyder 1993, 94)

Autonomy, history and language bind the fabric of ethnic identity. Striking all three, Georgia continued its policy of unraveling the Abkhaz. The latter's attempts to seek a political solution fell on deaf ears in Tbilisi. With its ethnicity in jeopardy, Abkhazia declared independence. When Georgia entered Sukhumi in 1992, its policy, as perceived by the Abkhaz, shifted to one of minority extermination.

As outlined in chapter 2, on television Karkarashvili promised to leave the entire Abkhaz nation without dependents. Khaindrava stated that they only needed to kill 15,000 Abkhaz to destroy the genetic stock. The Georgian forces burned the Abkahz Institue of Language and Literature: the center of Abkhazian culture and ethnic identity. The Georgian forces also committed atrocities against the Abkhaz when they entered Sukhumi.

> The UNPO [the Unrepresented Nations and Peoples Organization] gathered considerable evidence of persistent brutality of Georgian troops against Abkhazians and other non-Georgians, which, the Delegation felt, could not be attributed solely to the lack of discipline in the armed forces. There was widespread looting and destruction of houses and cultural institutions of Abkhazians and of other non-Georgian minority peoples of Abkhazia by the Georgian military and their supporters. The delegation spoke to victims and witnesses of torture, beatings and killings of civilians, including pregnant women

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and children, by Georgian troops. Allegations of atrocities committed by Georgian troops were confirmed by responsible Georgian officials. (Ennals 1992, 343)

In its interaction with the Georgian government, the Abkhaz movement evolved from political to military to mass retaliation. The Abkhaz people had first voiced their grievances to Moscow and Tbilisi. When this failed, they joined forces with the peoples of the northern Caucasus and fought the Georgians militarily. After fighting the Georgians in several battles, the Russians brokered a cease-fire.

In September 1993 the Abkhaz broke the cease-fire and began an all out offensive against Georgian forces. By October the Separatist forces controlled Abkhazia, and thus began a period of retaliation against ethnic Georgians still residing in Abkhazia. During and following the fighting in October 1993, two-hundred and fifty thousand ethnic Georgians previously living in Abkhazia were forced to evacuate the country, traveling by foot across the mountains into Mingrelia or Svanetia, or by boat out of one of the port cities. The papers in Tbilisi portrayed vivid images of dead Georgians lining the beaches in Sukhumi.

A history of ethnic discrimination by the Georgians against the Abkhaz dating back hundreds of years has already been outlined in chapter 2. Laws in the late 1980s and early 1990s pertaining to citizenship, land, and language, enacted by the Georgian government, again threatened the existence of the Abkhaz people. When these laws were enacted, Abkhazians feared the survival of their ethnic distinctiveness. When the Georgians entered Sukhumi, the Abkhaz feared for their lives.

Partly through the interaction with identity entrepreneurs, like Zviad Gamsakhurdia, partly through the interaction with the failing Russian government, and

partly through self-generation, the Georgian government evolved in the early 1990s into an ethnocentric, nationalistic regime. With a change in the Georgian political elite so too came changes in the governmental institutions and their treatment of minorities. As the Abkhaz people interacted with an evolving nationalist government in Tbilisi, combined with the mounting demographic pressure of loosing all of Abkhazia as outlined in Chronicle 4, the Abkhazians too evolved. Abkhazians went from a people seeking autonomy through political means to a well-armed, atrocity committing group hell-bent on forcing all Georgians out of Abkhazia and creating a separate state.

As in the ecological disaster example, the Abkhazian example helps demonstrate how interacting elements within a system can adapt or coevolve. In this evolution, emergent properties within the Abkhaz arose to include ethnocentrism, militarism, and hatred towards the Georgians. Although their historical context is not covered in the description above, two other emergent properties arose within the Abkhaz. These were distrust of international organizations, like the United Nations, and dependence on the Russian government. With either example, the ecological disaster or the Abkhaz, feedback loops, discussed next, after each interaction or period of self-generation caused adaptation or coevolution to occur. Furthermore, the increased frequency of feedback caused the elements within the system to undergo punctuated equilibrium and pushed the system as a whole into chaos.

<u>Feedback and Finite Bounds</u>

Closely related to interactions is the chaos principle of feedback. Feedback is the input into an element that results from an interaction. Feedback can have two effects on a system. It can either excite it or equalize it.

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Feedback can get out of hand, as it does when sound from a loudspeaker feeds back through a microphone and is rapidly amplified to an unbearable shriek. Or feedback can produce stability, as a thermostat does in regulating the temperature of a house: any temperature above a fixed point leads to cooling, and any temperature below it leads to heating. (Gleick 1988, 61)

In scientific terminology, positive feedback increases, or accelerates, interactions; negative feedback decreases, or decelerates interactions. However, since this paper examines ethnic conflict, the qualitative terms of positive and negative are used in reference to human behavior or actions. In this thesis, the term negative feedback refers to input that leads to negative responses. These are actions that promote, accelerate, or increase the current or the likelihood of conflict. Positive feedback refers to input that leads to positive responses. These are actions that promote, accelerate, or increase the current or the likelihood of resolution or well being.

Although Gleick's examples of feedback pertain to machines, feedback can also be seen in social systems. For example, the Russians recently imposed their own form of self-regulating thermostat in Chechnya. Vying for independence, Chechen rebels heated the situation up to the point that Russia took military action. They entered Chechnya and somewhat systematically curtailed the rebels' ability to conduct combat operations, leveling Grozny in the process. Remnants of rebel groups fled into the mountains where they hide, rebuild, and begin at some later time another cycle of insurrection. This situation will likely heat up again next year or next decade, and the Russians will return. The latter's imposed acquiescence of the Chechens acts as a thermostat to maintain the system within acceptable bounds.

GA₁ = Georgian government attacked Abkhaz ethnicity, language, and citizenship

GF₁ = Fear of Losing Abkhazian territory

GA₂ = Mobilized troops, entered Sukhumi, committed atrocities, burned cultural center

GF₂ = Hatred for Abkhaz imprinted on Georgian ethos; fear of Russia

EA₁ = Political protesting to Russia and Georgia

EF₁ = Abkhaz shut out of Georgia's government and the media

EA₂ = Joined the Northern Caucasus; declared independence

EF₂ = Fear of existence; galvanize ethnic group

EA₃ = Armed; pushed Georgian military out of Abkhazia; 250,000 Georgians forced to flee; atrocities committed

Stage 1 — Government → GA₁ → Ethnic Group ← EA₁
Stage 2 — Government ← EA₂, EF₁ → Ethnic Group
Stage 3 — Government → GA₂ → Ethnic Group → EF₂
Stage 4 — Government ← GF₂, EA₃ → Ethnic Group

LEGEND
EA = Ethnic (Abkhaz) Action
EF = Ethnic Feedback
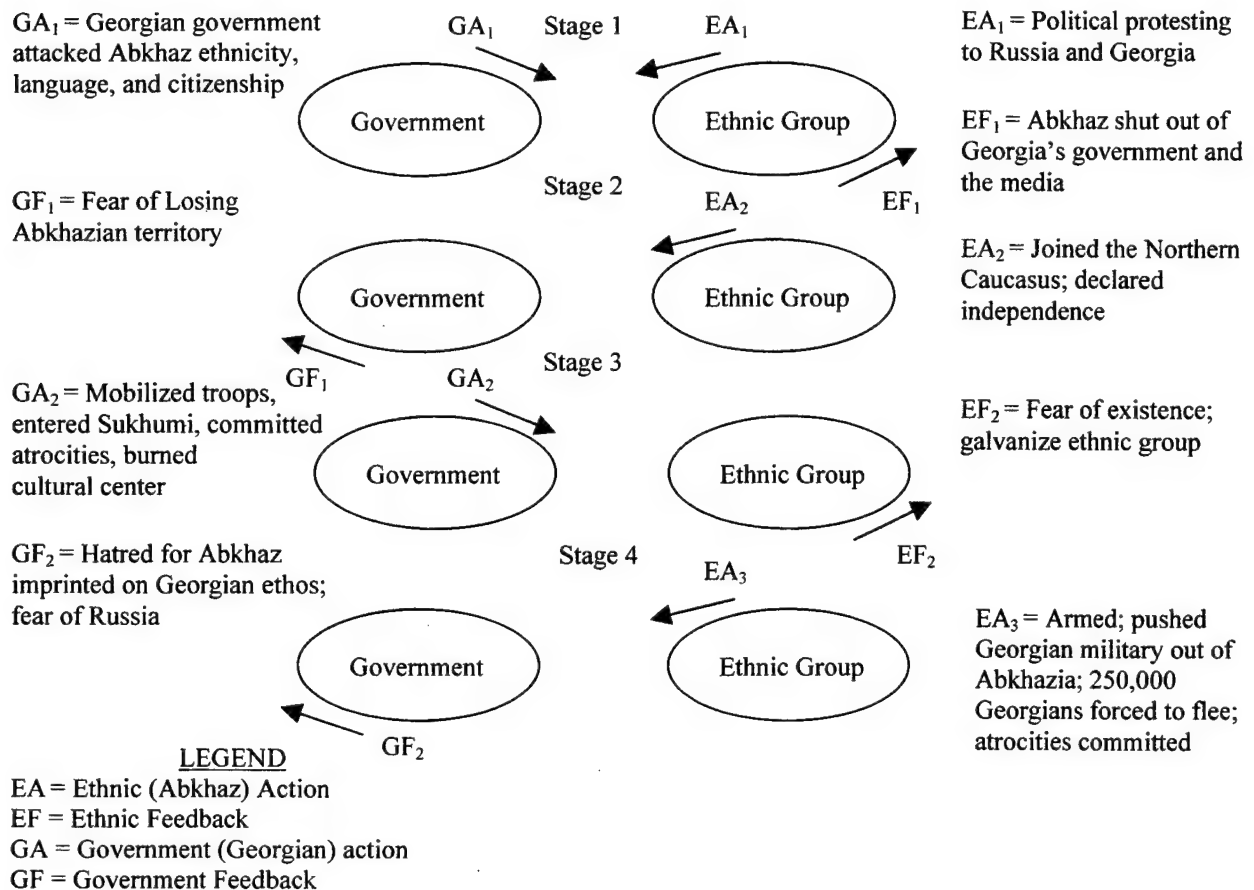GA = Government (Georgian) action
GF = Government Feedback

Figure 2. Ethnic Conflict Feedback Loop

Feedback with each interaction between the Abkhaz and the Georgian government induced each to adapt and evolve. In addition, unlike the Chechnya example where feedback stabilized the system, in Abkhazia feedback excited it. As depicted in figure 2, during each interaction, the action of one group induces feedback in the other. Based on this new set of conditions, an action is taken in response, which is then fed back into the original acting element. It is understood that figure 2 is very simplistic in its representation of interaction and feedback.
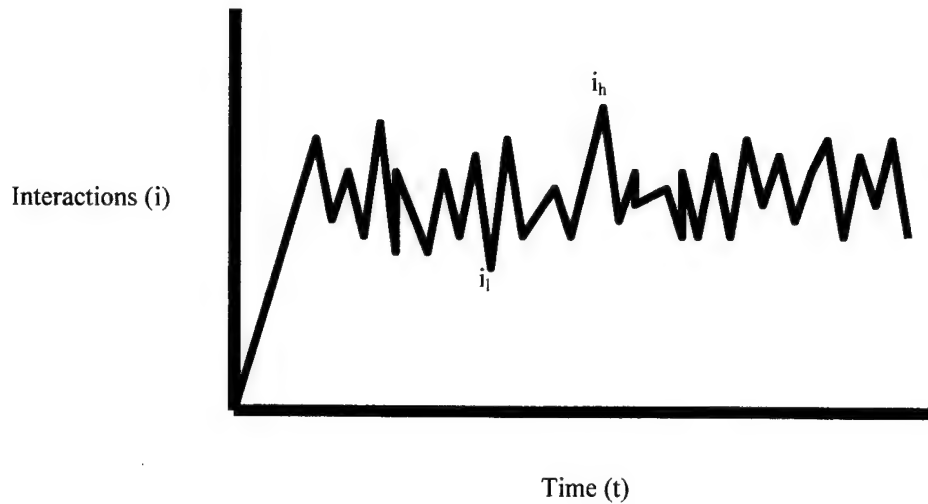
Figure 3. Interaction or Feedback over Time

As seen in the Abkhaz example, interaction and feedback are very complex, intertwining both the internal organs within each of the elements and the numerous elements within the system as a whole. In addition, the frequency of feedback and interaction between elements within a system can also fluctuate. In figure 3, the numbers of interactions within the system appear to fluctuate. Although chaotic, the number of interactions appears to be self-regulating. That is, the numbers of interactions remain within the bounds as depicted by a low (i_l) and high (i_h) extreme. Bounds, or more precisely finite bounds, is another principle of chaos theory. The concept of finite bounds within chaos is that although a systems trajectory may not be able to be predicted, the system remains within a given set of parameters. Attractors within the system control these parameters. Attractors are areas where events converge.

Because of its chaotic nature, one may not be able to predict the next event within an ethnic conflict. However, in relation to figure 3 one may be able to determine the

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bounds of the conflict $(i_h - i_l)$ and the frequency of cyclic events $(i_l$ to $i_h)/t$. Analyzing this concept, one may suggest that the implied assumption is that interactions between elements produce feedback with only negative emergent properties. This is not the case.

An increase in the frequency of negative interactions between two elements may cause the system to reach a point where the numbers of interactions decline. A cooling period follows, and the cycle begins again. This concept goes back to self-regulation, the thermostat analogy, or the Chechnya example. Of equal importance is the concept that positive feedback can be self-regulating as well.

Positive interactions and feedback between two elements may reach a point where one or both elements begin fearing the loss of their own core identity. In an effort to maintain distinctiveness, positive interactions decrease, or negative interactions increase. This cycle of attraction and repulsion is not unsimilar to that which the countries under the European Union (EU) will perhaps experience for the next several decades.

The concepts of interactions and feedback can also be related to the conflict in Bosnia. The increasing number and frequency of negative actions and negative feedback carried that country into war in 1992. Interactions remained almost entirely negative between the fighting groups with the relative frequency of negative actions fluctuating until the signing of the Dayton Peace Accords. Although negative interactions continue, positive interactions and positive feedback is beginning to emerge in greater frequency and amplitude.

The organizations in Bosnia representing the International Community (IC) hope that their presence acts as a suppressor on the number of negative interactions while

fostering the positive ones that emerge. These organizations also hope that with time the number and frequency of positive interactions will reach a point where the negative ones no longer threaten stability. Going back to the concept of the attraction and repulsion cycle, one can appreciate the length of time involved in such an endeavor.

This section helps demonstrate the relationship between the chaos and complexity theory principles of feedback and finite bounds with the factors of ethnic conflict. Figure 2 takes these principles and applies them to the ethnic conflict in Abkhazia during the early 1990s. Figure 3 also helps demonstrate bounds within chaos and the concept of self-regulation. In addition, figure 3 introduces the concept of prediction.

Although not an exact science, identifying the bounds of a system currently experiencing chaos provides the policy maker or military commander with three advantages. First, it does narrow the scope. "Of all the possible pathways of disorder, nature favors just a few" (Gleick 1988, 267). Second, it does provide an indication of the flexibility or adaptability that must be inherent within US foreign policy that is attempting to influence the system and the type of military force that may be needed to intervene. Lastly, it provides an appreciation of the complexity of the environment.

> By post-Newtonian, we mean the arrangement of nature--life and its complications, such as warfare--is nonlinear. It defines activities in which inputs and outputs are not proportional; where phenomena are *unpredictable, but with bounds, self-organizing*; where unpredictability frustrates planning; where solution as self-organization defeats control; and where a premium is placed on holistic, intuitive process. It rewards those who excel in the calculus of bounds as the variable of management and control. (Czerwinski 1996, 126)

This paper has so far compared four of the five factors of ethnic conflict to a variety of principles of chaos and complexity theory. In Czerwinski's comment above, he mentions disproportionate inputs and outputs. Although slightly different wording,

this concept is the same as the chaos and complexity principle of disproportionate effects. This area is discussed the next section, especially in its relationship to the last ethnic conflict factor to be analyzed: tipping events.

<div align="center">Disproportionate Effects</div>

In a complex adaptive system as detailed in chapter 2, outputs are not directly proportional to inputs as seen in linear systems. Because of the number of elements and their interrelationships with each other, small inputs can ripple though a system, cascading into large outputs.

> It follows from the vulnerability of complex adaptive systems to punctuations of their equilibrium and tumultuous phase transitions that small, seemingly minor events can give rise to large outcomes, that systems are sensitive at any moment in time to the conditions prevailing at the moment and can thus initiate processes of change that are substantial and dramatic . . . It is not difficult to reason, for instance, that the end of the Cold War began with the election of a Polish Pope more that a decade earlier, just as the release of Nelson Mandela from prison was arguably (and in retrospect) an event that triggered the end of apartheid in South. Africa (Rosenau 1997, 86)

This paper has already used the examples of dead American soldiers in Somalia, the assassination of Archduke Francis Ferdinand in Sarajevo in 1914, and Slobodan Milosevic's trip to Kosovo in April of 1987 to help demonstrate the concept of disproportionate effects to real world events. However, these three events are not only examples of disproportionate effects, they are also examples of tipping events as well. Although the terms and context are different, their meaning is the same.

As detailed in chapter 2, tipping events are those events that serve as catalysts to galvanize a group to the point of political action. The Rand study uses the descriptive term of "escalating spirals" to help define the meaning of tipping events (1997, 91). This descriptive term is no different from that of Rosenau's comment above where,

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"seemingly minor events can give rise to large outcomes" (1987, 86). When a complex adaptive system is sitting at the edge of chaos--the Balkans in the late 1980s, Abkhazia in the early 1990s, or Rwanda in 1993-1994, tipping events are those events that push the system over the edge. Chaos and perhaps punctuated equilibrium follows. Relating back to the concepts of co-evolution, adaptation, and emergent properties, new organizational structures may then begin to appear from the morass.

The paragraphs in this section above help demonstrate the relationship between the chaos and complexity theory of disproportionate effects to the ethnic conflict factor of tipping events. However, the former does play a much broader role in explaining complex systems such as an ethnic conflict. The principle of disproportionate effects is intertwined with the principle of feedback and may provide insights into the best course of action when intervention is being considered.

As depicted in figure 2, the interaction between two elements causes feedback in both. However, the feedback may be disproportionate to the initiating action. A disproportionate response is then launched. These "escalating spirals" can quickly pull a system into chaos. Georgian laws during the late 1980s and early 1990s pertaining to language and citizenship may have been minor events in Georgia's eyes as they attempted to define their new national identity. However, they were catastrophic events for the Abkhaz and for most of the nonethnic-Georgian inhabitants living in Georgia. The country imploded.

Disproportionate effects do not only work in reference to escalation described above, but are also related to the concept of diminishing returns. As stated, in linear systems a little input produces a little output, and a large input produces a large output.

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However, in nonlinear systems a point can be reached where the amount of output corresponding to an increasing amount of input diminishes. The rapid escalation of US forces into Vietnam during the mid 1960s quickly reached a point of diminishing returns. In fact, one might say that in this example the input folded in on itself, a chaos principle relating to attractors and fractals, not only reaching a point of diminishing returns, but negative feedback as well.

For the people in Washington who draft foreign policy or for the military commander charged with the task of armed intervention, the concept of disproportionate effects is critical. By understanding the system, one may be able to apply the appropriate response. These individuals may ask analysts what small interactions with an outside element, like the US, might have the potential of causing outcomes far from the desired endstate. These individuals may also ask how much foreign aid is needed or what size of force is needed to produce the desired endstate before reaching the point of diminishing returns. For example, how many Stabilization Force (SFOR) troops need to remain in Bosnia to accomplish the mission? When can NATO begin to draw down the size of the Kosovo Force (KFOR)? How big does the hammer have to be?

As US foreign assistance continues to be spread thinly around the world, the answers to such questions would prove invaluable. These answers may help curb the use of cookie-cutter responses to complex situations, or they may also be able to define those times when no response is the best, though least desirable, course of action. In applying the concepts of chaos and complexity theory to the analysis of ethnic conflict, the analysts may someday be able to provide some definitive answers to these questions.

Conclusion

Chapter 2 answers the first two secondary research questions by defining the principles of chaos and complexity theory and the factors of ethnic conflict. The previous five sections of chapter 4 answer the third and final secondary research question be systematically examining a number of chaos and complexity principles and then relating them to the five factors of ethnic conflict. A fictitious ecological disaster and the events in Abkhazia during the early 1990s help demonstrate this relationship.

The four factors of ethnic conflict illustrated in the ECCM--mounting demographic pressures, identity entrepreneurs, governmental structure, and ethnic discrimination, interrelate, causing feedback, adaptation, and coevolution. Tipping events effect the whole system, accelerating the frequency or character of the interactions. A principle or a combination of principles of chaos and complexity theory to include self-organization, adaptation, coevolution, emergent properties, feedback, accelerators, fractals, finite bounds, and disproportionate effects are then used to help explain each of the interactions or the behavior of the system as a whole. The potential utility of these principles in analyzing ethnic conflict is demonstrated: the last secondary research question and the primary research question of this thesis answered.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Big whorls have little whorls
Which feed on their velocity,
And little whorls have lessor whorls
And so on to viscosity

Lewis F. Richardson (Gleick 1988, 119)

Answering the Primary Research Question

Phase I in chapter 2 answers the first secondary research question: what principles of chaos and complexity are pertinent to the study of ethnic conflict? This is accomplished through literature review, explanation, and analysis. Phase I first reviews the research works of Gleick (1987), James (1996), Waldrop (1992), and Czerwinski (1997 and 1998), among others. From these studies one can recognize the importance that chaos and complexity theory will play in future generations.

Chaos and complexity are the science of systems. With the aid of computers, one is able to analyze interactions and relationships in systems with three or more variables. James (1996) asserted that chaotic systems are bounded, nonlinear, non-periodic, sensitive to small disturbances, and mixing. Rinaldi (1997) suggested that complex systems have four tenents: emergence, self-organization, evolution at the edge of chaos, and the ability to process information. Crutchfield (1986) stated that chaos theory might provide insights into relationships where previously none were thought to exist. Jervis (1997) took this concept a step further in his examination causal relationships and unintended consequences within a system.

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Rinaldi (1997) discussed humanity's important and necessary leap from Newtonian reductionism to complexity. Rosenau (1997) and Mann (1997) asserted the need to apply the theories of chaos and complexity to world systems. In addition, like Rinaldi, Rosenau emphasized the need for humanity to shift from Newtonian reductionism to the complexity paradigm. Mann also suggested the importance of recognizing that sometimes chaos is good: an insightful concept whenever considering military intervention. Finally, Beyerchen (1997) recommended that research continue in modeling systems using chaos and complexity. "We do not know enough about the new sciences to apply them very well yet, but every attempt helps us learn and adapt to the changes with which we must cope" (1997, 168). This thesis is an addition to this new body of research.

From William's (1997) sixteen principles of chaos theory, phase I in chapter 2 narrows the field to six: deterministic, feedback, self-generation, finite variables, sensitivity to initial conditions, and fractal properties. The nine principles dismissed from William's list are either assumed to be already present within the complex adaptive system of the ECCM, pertain to systems in transition to chaos, or are designed specifically for mathematical applications of chaos theory and thus non-relevant to this thesis' line of inquiry. The six principles chosen are in accord with the must have and might have principles of chaos asserted by James (1996).

Phase I also lists the four principles of complexity theory: self-organization and emergent properties, adaptation or co-evolution, disproportionate effects, and sensitivity to initial conditions. These four principles of complexity theory are taken from the study by Rosenau (1997) and are in accord with other important works in the field to include

Waldrop (1992). The six principles of chaos theory and the four principles of complexity theory were selected because, combined, they capture the essence of the two theories as described in the various works reviewed in chapter 2. In addition, they were picked because of their scope, scale, lack of dependence on mathematical equations, and ability to be individually compared to the factors of ethnic conflict.

Phase II in chapter 2 answers the second secondary research question: what are the common factors found in ethnic conflict? This is accomplished through literature review, explanation, and analysis. This phase uses the 1995 and 1998 State Failure Task Force reports, the Baker and Weller study (1997), and the Rand study (1997). The task force analyzed historical data on state failure collected from 1955 to 1996 and compared it to seventy-five variables or characteristics of state collapse. The task force asserted that their model could predict state failure with two-thirds accuracy for those states likely to fail within a two-year period. The task force also identified accelerators, de-accelerators, and triggers of conflict: concepts that can be directly compared to the principles of chaos and complexity theory such as feedback and disproportionate affects.

The Baker and Weller study (1998) discussed five stages of state collapse or conflict. These phases can be compare to a complex system moving from complexity through the edge of chaos and into chaos. This study also used twelve factors of ethnic conflict that are of primary importance in the development of the five factors used in this study. Using only three phases instead of five, the Rand study (1997) also followed a state through transition to collapse. The Rand study listed nine factors of ethnic conflict that contribute to this collapse. At the end of phase II in chapter 2, the factors in the Rand study are correlated with the factors found in the other two studies.

The factors of ethnic conflict are narrowed to five: identity entrepreneurs, ethnic discrimination, tipping events, governmental structure, and mounting demographic pressures. As one can see in table 1, these five factors encompass the other factors used in the three studies identified above. It is these factors that are then compared to the principles of chaos and complexity identified earlier in phase I.

Phase III in chapter 4 answers the third secondary research question: what is the applicability of chaos and complexity theory in analyzing ethnic conflict? This is accomplished through the comparison of the principles of chaos and complexity from phase I to the factors of ethnic conflict from phase II. Phase III uses explanation, analysis, modeling, and specific examples of ethnic conflict to demonstrate this relationship.

Phase III first introduces the Ethnic Conflict Complexity Model (ECCM). This model consists of the elements of identity entrepreneurs, ethnic discrimination, governmental structure, and mounting demographic pressures. It is the interactions within each and between the elements that the principles of chaos and complexity are applied to the model. The fifth ethnic conflict factor, tipping events, permeates each of the individual elements and the system as a whole.

Section three of chapter 4 compares the chaos and complexity principles of self-organization and emergent properties to the ethnic conflict factor of mounting demographic pressures. Using an ecological disaster example, the reader is able to see how a disaster can occur entirely within one element: the environmental system. Since the heavy rains are part of the environmental system, the ecological disaster is then self-generated. The self-generated disaster created new properties within its encompassing

element. These emergent properties included famine and disease. This example also demonstrates the principle of sensitivity to initial conditions. The soil was not capable of absorbing the extra water during the heavy rains. Thus, the heavy rains caused a spiraling effect throughout the entire ecosystem.

Section four of chapter 4 compares the chaos and complexity principles of adaptation and coevolution to the ethnic conflict factors of mounting demographic pressures, governmental structure, identity entrepreneur, and ethnic discrimination. Continuing with the ecological disaster example, the reader can see how through the interactions between the four elements of the ECCM, the rural community evolves into an armed and angry group. The government also evolves, becoming nationalistic and ethnocentric. An emergent property is hatred on both sides. The ethnic conflict factor tipping events is also introduced in this example since the flood caused acceleration in the number interactions in the ECCM beyond the constituent elements' ability to cope.

Section four also uses the 1990-1993 Georgia or Abkhaz example to demonstrate adaptation and coevolution. In response to the Soviet Union's demise, the Georgian government evolves, becoming nationalistic. Fearing ethnic survival, the Abkhaz also evolve, becoming an armed, reprisal seeking, and atrocity committing populace. With each interaction and feedback loop, the Georgian government and the Abkhazians adapt and evolve to the other's actions. The situation deteriorates to armed conflict and ethnic cleansing.

Section five of chapter 4 compares the chaos and complexity principles of feedback and finite bounds with the ethnic conflict factors of governmental structure and ethnic discrimination. This section demonstrates how feedback loops within the ECCM

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cause adaptation and evolution. In Figure 2, the reader can see how each action by the Georgian government led to feedback within the Abkaz element. This feedback then leads to adaptation and response in the subsequent interaction. Feedback cycled through the government, producing adaptation, evolution, and emergent properties that, in turn, effect the next cycle of interaction. Related to the principles of adaptation and evolution, this section also discusses self-regulating and escalating feedback. The former is like the heater and thermostat: each working off the other to keep the temperature constant. Escalating feedback occurs when interactions spiral off each other until the system is out of control. Chechnya is an example of the former while Rwanda in 1994 is an example of the latter.

As introduced above, section five of chapter 4 discusses the concept of finite bounds. "Of all the possible pathways to disorder, nature favors just a few" (Gleick 1987, 267). This concept becomes critical in the analysis of complex systems for the purpose of determining the correct measure of military intervention. If one is able to predict the bounds of a conflict, then the commander can develop a force that has the agility to operate within those bounds.

Section six of chapter 4 compares the chaos and complexity principles of disproportionate effects and, to some extent, feedback with the ethnic conflict factor of tipping events. As discussed in this section, the assassination of Archduke Ferdinand, Slobodan Milosevic's 1987 trip to Kosovo, and the 1993 thirty-second spot of dead American soldiers being drug through the streets of Mogadishu are all examples of tipping events. However, they are also examples of disproportionate effects: outputs not

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in proportion to inputs. Although terminology and reference are different, the concepts of tipping events and disproportionate effects are the same.

Phase I establishes the principles of chaos and complexity. Phase II establishes the factors of ethnic conflict. Through the use of the ECCM, Phase III demonstrates how interactions between the five elements, or ethnic conflict factors, can be explained using the principles of chaos and complexity. These three phases of analysis and the entire paper as a whole, from introduction to conclusions, through the continuous use of explanations, analysis, modeling, historical examples, jumping from the particular to the holistic, answer the primary research question: can the principles of chaos and complexity theory aid in the analysis of ethnic conflict? Yes.

Ethnic differences whether they stem from language, religion, culture, or race can be self-generated. Interactions between ethnic factors produce feedback, leading to emergent properties that may or may not be disproportionate to the intended input and that effect the next interaction causing adaptations and coevolution. Systems, like ethnic conflict, may slip into chaos, undergo punctuated equilibrium, or organize into complex structures. Lastly, somewhere in the chaotic morass the system has bounds.

<u>Significance of Study</u>

Although currently far from providing a predictive tool, the understanding of the principles of chaos and complexity and their relationship to ethnic conflict, as demonstrated in this thesis, is of value. If one understands the principles, then one has a frame of reference on which to analyze the events of a complex system like ethnic conflict. One may be able to determine if clashes between groups is self-regulating or escalating. One may be able to determine the bounds of the conflict. By identifying

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emergent properties, one may be able to determine which and how different groups will evolve. One may be able to determine if a conflict is on the edge of chaos. And one may be able to identify the type and amount of intervention needed to prevent such a catastrophe. No longer do intelligence analysts need undergo the mental mind miracle described in chapter 1. The principles of chaos and complexity theory provide a cognitive roadmap.

This study may prove to have a greater impact on the development of military doctrine than just the introduction of an ethnic conflict model. This thesis helps to open the door for future studies in military doctrine development based on the science of systems. Doctrine based on the new sciences is likely to have a better chance of surviving the test of time. Currently, only two constants exist in the military. The first is change.

It has been predicted that technology will continue to advance exponentially into at least the next several decades. Therefore, to maintain a technological advantage, US military systems will need to be developed at a faster and faster rate. This development cycle has and will continue to outpace the military's ability to develop doctrine for these new systems. In addition, even if new doctrine is developed, its shelf life will continue to diminish. Soon equipment-based doctrine may not even make it beyond the draft stage before the equipment or equipment systems that it encompasses become obsolete.

The concept of change may not only be applied to military equipment systems but mission focus as well. A military unit must now be prepared for the entire spectrum of conflict. In the future, the fitness of a unit may be measured less on its ability to conduct

a specific mission and more on its ability to adapt. If change is a constant, then military doctrine needs to embrace it.

Newtonian reductionism is the science of equilibrium and stasis. However, as one sees in nature, economics, and populations, the world and the systems within it are dynamic, constantly evolving, devolving, changing, unfolding, and unpredictable. "If nature uses certain principles to create her infinite diversity, it is highly probable that those principles apply to human organizations" (Wheatley 1992, 143).

The principles of chaos and complexity theory such as adaptation, evolution, emergent properties, finite bounds, and self-organization may provide insight into how to develop an Army that is able to cope with an ever changing and complex world. As stated by Wheatley (1992), the development of organizations should at least be grounded to the science of the times. In the development of a new military structure, it is time for the military to discard the concepts of Newtonian reductionism, and explore the science of systems. It is time for the military to have a meaningful look at chaos and complexity.

In the development of a new military structure, using world complexity models based on the principles of chaos and complexity theory, the military may also be able to predict with some accuracy what changes need to take place now in order to meet the challenges of the future. As stated earlier, chaos and complexity are tools that aid in the understanding and shaping of the first constant in the military. They are also tools that can help maximize the full potential of the second constant: man.

Equipment keeps changing. In fact, as illustrated above, equipment will continue to change at an ever-increasing pace. Man remains the constant in the military equipment

arsenal. Military doctrine that addresses a constant rather than a variable has a greater chance of having a lasting impact. But this is no easy task.

Equipment systems are far easier to master. They can be touched, manipulated, adjusted, and probed. Humanity is far more complex, and future doctrine focussed on the improvement of it will come to explore its own version of Alice's rabbit hole. The proverbial Cheshire cat and Queen of Hearts to be found are likely not to fit into neat and tidy boxes. Because of this, some consider it best to leave this area unexplored. As outlined in chapter 1, this dilemma is why one finds a book with ninety-three pages on intelligence lessons learned of which less than a page is devoted to the problem of analyzing the enemy. However, this is not the time to hide. Stated earlier by Ralph Peters, "Man, not space, is the last frontier. We must explore him" (1999, 172).

As detailed in chapter 1, it is time for mankind to take the next major step in cognitive thought. One such step occurred three hundred years ago with the advent of Newton's three laws of motion and the concept of the Clockwork Universe. This change in man's fundamental thought processes led to the development of the sciences of biology, chemistry, and physics, leading to most of the technological advances seen in the world today. It also led to inductive and deductive reasoning, and linear analytical methods such as the military decision making process (MDMP). However, mankind has hit an impasse. All parts have been categorized. All pieces quantified. One must now look and, more importantly, think beyond the science of parts to the science of systems.

Chaos and complexity theory have the potential to revolutionize military leadership doctrine. With the aid of computers, military leaders can now break away from the thought processes of Newtonian reductionism. Those who can make the change

to the science of systems will be better equipped to understand and cope with complexity

and chaos. They will understand bounds, disproportionate effects, self-generation, and

feedback. These leaders will be able identify the subtle patterns in a chaotic system,

develop the correct force structure, and apply it appropriately.

> The timelessness of Clausewitz will inevitably be revitalized by the
> incorporation of post-Newtonian scientific terminology, replacing that of the
> prevailing science of Clausewitz's own era--the branch of physics known as
> statics. It will be more biological. "Centers of gravity," "friction," and "mass"
> will give way to nonlinear concepts, including those rooted in thermodynamics.
> The commanders of tomorrow will wrestle with "entropy" and "phase states,"
> while grasping "periodic and strange attractors" as they search for "fractals" and
> "emergence."
> To use whitewater rapids as a metaphor for the chaotic battlespace, the
> *directing* commander applies his skills and sources to traverse the turbulence
> through a pragmatic mix of direct address and portage. The *plan* commander
> builds a dam to elevate the water level to submerge the rocks. The *influencing*,
> nonlinear commander, like the kayaker, conquers whitewater by "reading" the
> turbulence, immersing himself in it, and combining technology, organization, and
> concept to exploit it. If turbulent times await us, which method of command will
> best prepare us to cope with them? (Czerwinski 1996, 131)

Those leaders who remain seated in Newtonian reductionism will continue to be

confounded by emergent properties in an ever-changing environment. Those able to

make the mental leap will reap its rewards. ". . . a premium is placed on holistic, intuitive

process. It rewards those who excel in the calculus of bounds as the variable of

management and control" (Czerwinski 1998, 126).

This thesis does not assert that it provides all the answers to the doctrinal

shortfalls described above. It only tries to address the intelligence doctrine gap illustrated

by MG Thomas: "Nobody has broken the code on how to do analysis." The ECCM and

the use of the principles of chaos and complexity as illustrated in chapter 4 may help

intelligence analysts with mental mapping, leading to a better understanding of the

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complex dynamic of ethnic conflict. Future studies may also lead to a more definitive ethnic conflict model, or complexity models in general, that then aid in prediction. In this respect, this study addresses and helps to improve the military constant man.

This thesis does assert that future doctrine based on chaos and complexity theory is likely to have a far more profound and lasting impact on force structure than doctrine based on the sciences of Newtonian reductionism. The science of systems is the science of our times. The world is becoming far too complex to continue to view it in pieces and parts. In some small measure, this thesis helps open the door for future studies and military doctrine changes based on these new principles.

Areas for Future Study

Although this paper does answer the primary research question, demonstrating the potential of chaos and complexity theory in the analysis of ethnic conflict, a great deal more research has yet to be done. The ECCM is adequate for its purpose in this paper, but is limited if it is be used as a tool of analysis. Similar to Lewis Richardson's poem at the beginning of this chapter, ethnic conflict systems, their elements, and interrelationship are quite complex.

This paper also does not address self-organized criticality, pattern recognition, neural networking (the ECCM is too simplistic), or genetic algorithms. Although this paper provides insights for mental mapping of ethnic conflict, future studies may lead to the development of computer programs designed to help make method of the madness. Predictive programs using chaotic equations are currently being developed. With the help of studies such as this, a chaos computer program that addresses the uniqueness of ethnic conflict may soon follow.

If mathematics is found useful in predicting ethnic conflict, it should be understood that this would neither eliminate nor detract from the humanistic or individualistic quality of the analysis. It would be, however, negligent for an intelligence analyst to ignore such a predictive tool simply because of a prejudice of mathematical equations that explain human behavior.

> Using simple linear tools in complex nonlinear situations will provide misleading forecasts, a disaster for any business. More dangerous, however, is not making use of proven nonlinear tools to interpret and predict our complex environment—especially if competitors do! Using mathematics to describe the V shape naturally formed by a flight of Canadian geese over a lake in Montana neither eliminates the beauty of the flight nor takes away the freedom of the individual bird to fly as conditions and individual intentions permit. (Kelly and Allison 1999, 45)

Coping with Chaos

The United States will continue to become engaged in ethnic conflicts throughout the world. It has become an element of its post cold war nature formed partly because of the American belief in universal human rights, partly because of its expansionist philosophy of promoting democracy, partly because of its belief in maintaining the status quo in world stability, partly because of its role as the only remaining super-power, and partly because very few other countries will. Therefore, military commanders will continue to find themselves forced into ethnic quagmires. To keep up their end of the military battle operating system, now is the time for the intelligence community to develop doctrine directed towards this environment.

The military has published field manuals on top of field manuals covering the art of intelligence in predicting the old Soviet hordes coming through the Fulda gap, but none covering the complexities of ethnic conflict. This oversight is because in the former one can look at the enemy's equipment to determine his intentions, while the latter deals

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primarily with the irrational nature of man. The human mind is the most complex weapon ever devised. Without tools of analysis, understanding it becomes almost impossible. It is important to recognize that the human mind is also has the most advanced tool in the US equipment arsenal. It should be treated as such. No longer should the intelligence community man the equipment, but equip the man. As stated earlier, now is the time to think about how to think.

Finding tools of analysis that aid in the prediction of ethnic conflict ultimately serve the policy maker or military commander. These tools may either be rooted to the sciences of linear analysis founded in Newtonian reductionism or based on the new sciences of chaos and complexity. Although still in their infancy, the latter are likely to be of greater worth. There are few straight lines in nature. However, until these theories permeate the scientific and business communities, the individuals who attempt to apply them to intelligence analysis are definitely taking the road less traveled.

Nonlinear theories are not easy to master. They do not provide simple solutions. And their value, at first, may lie more in what they can't tell us than what they can. However, an understanding of these theories is necessary if one is to come to grips with the complexities and chaos that permeate the New World order.

> Inspiration unsupported by rigorous analysis become adventurism. Thus intuitive gifts must be paired with an effective theoretical framework. Chaos theory is uniquely suited to provide one such framework. It can provoke us toward realistic policies in an incessantly changeable age, and inaugurate the overdue liberation of strategic thought. (Mann 1992, 67)

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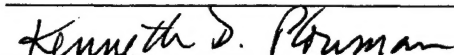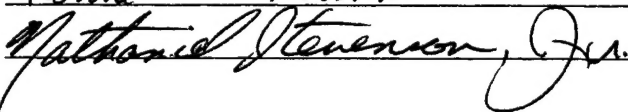
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